(12) UK Patent Application (19) GB (11) 2 313 885 (13) A

(43) Date of A Publication 10.12.1997

(21) Application No 9711400.3

(22) Date of Filing 04.06.1997

(30) Priority Data
(31) 19622843 (32) 05.06.1996 (33) DE
19622641 05.06.1996

(51) INT CL[6]
F16H 63/30, F16D 23/12 29/00

(52) UK CL (Edition O)
F2D DDA DD61 DD62 DD63
F2L LK L201 L202 L203 L211 L215 L218 L301 L501

(56) Documents Cited
GB 2207969 A GB 2161237 A GB 1185396 A
WO 95/35452 A

(58) Field of Search
UK CL (Edition O) F2D DBB DDA DDF, F2L LAX LK LR LT
INT CL[6] F16D 27/00 29/00, F16H 63/30

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(54) Powered actuator with variable spring bias

(57) An operating device 1 for controlling an operable control element of a vehicle transmission, for example for shifting and/or selecting the transmission ratio of a gearbox and/or for operating a clutch 2, has an electric motor 3 which rotates a shaft through worm gearing to cause a crankpin 10 to operate a master cylinder piston 12 through a rod 11. The rod 11 is biassed by a spring 25. Further spring biassing which varies with the movement of the piston is provided by an arrangement 50 comprising a spring-bissed roller acting on a cam 30 which rotates with the crank. In alternative arrangements the variable spring bias uses a linearly-moving surface with transversely-acting rollers or the roller may instead act on a rotary face cam.

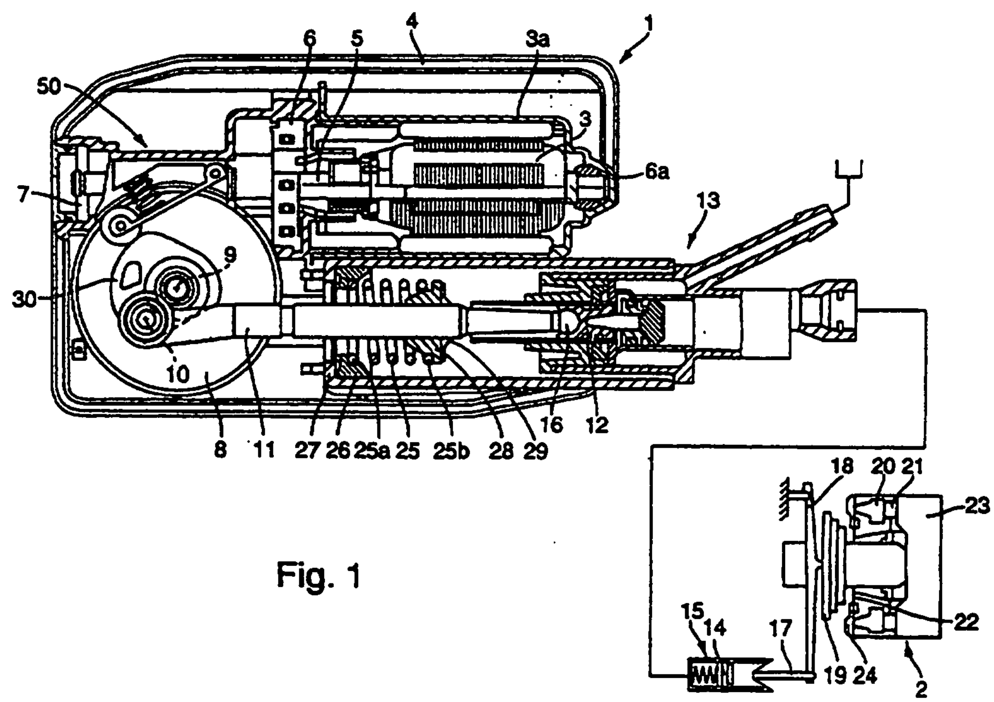

Fig. 1

GB 2 313 885 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

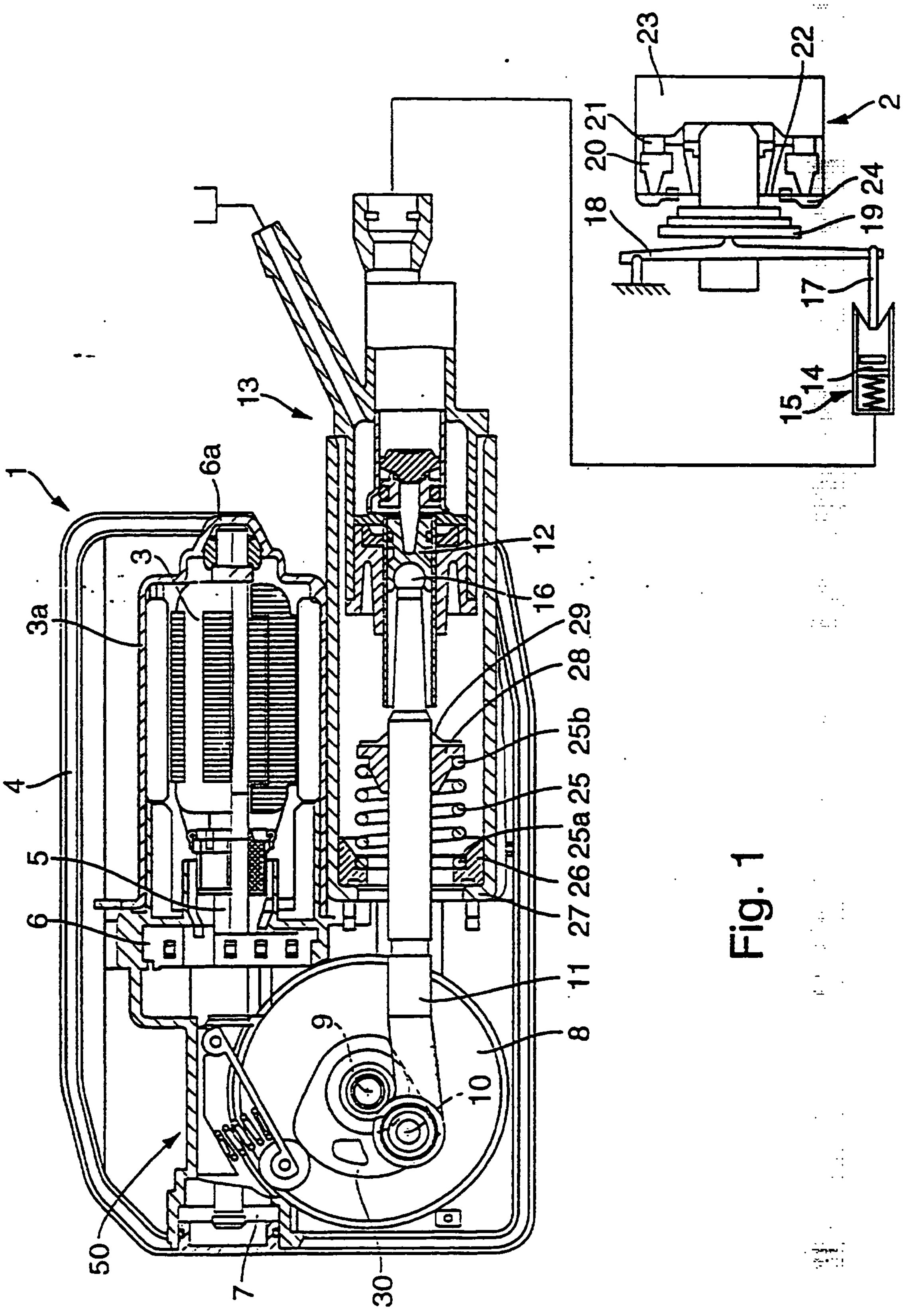

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Fig. 1

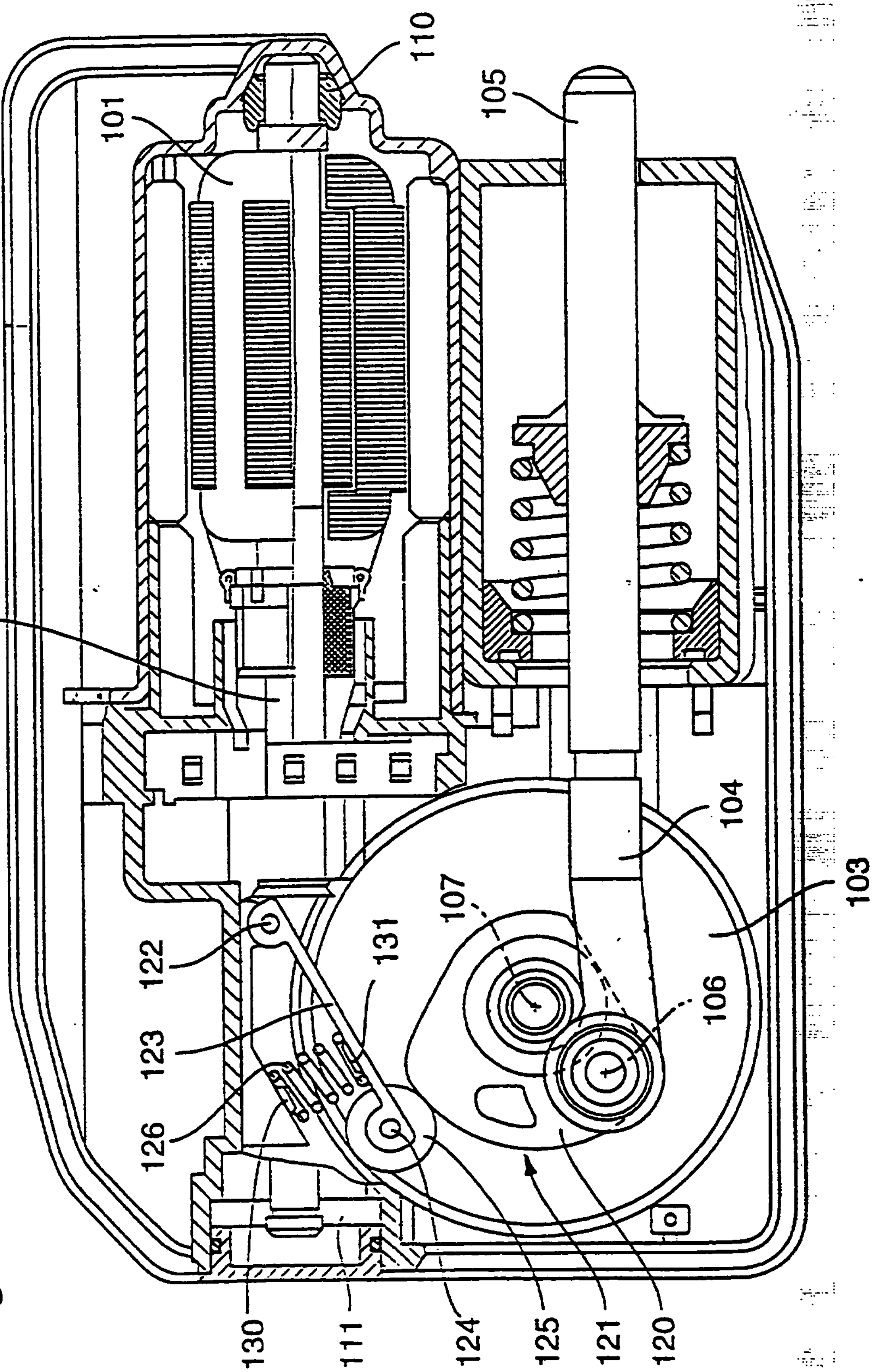
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Fig. 2

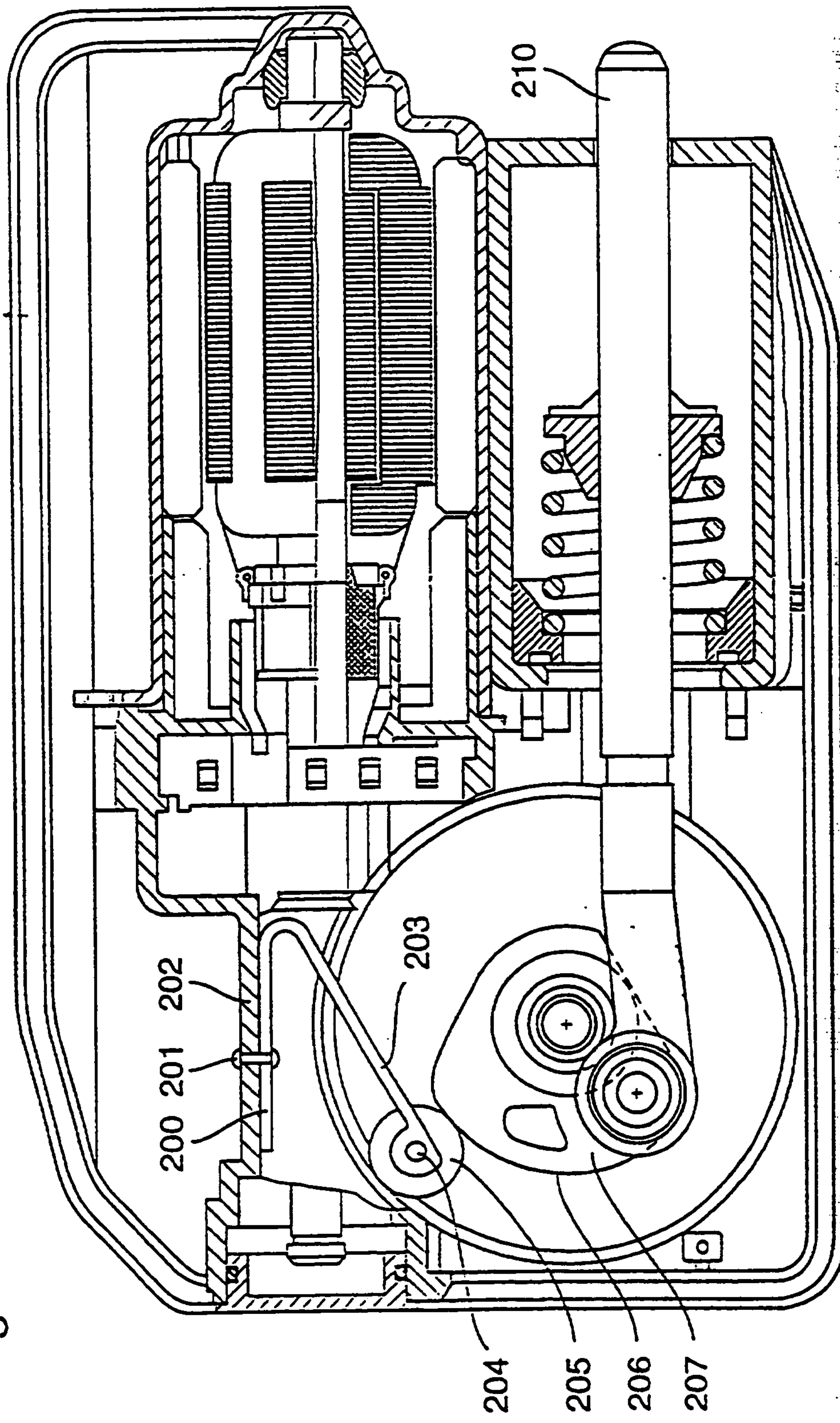


Fig. 3

Fig. 4

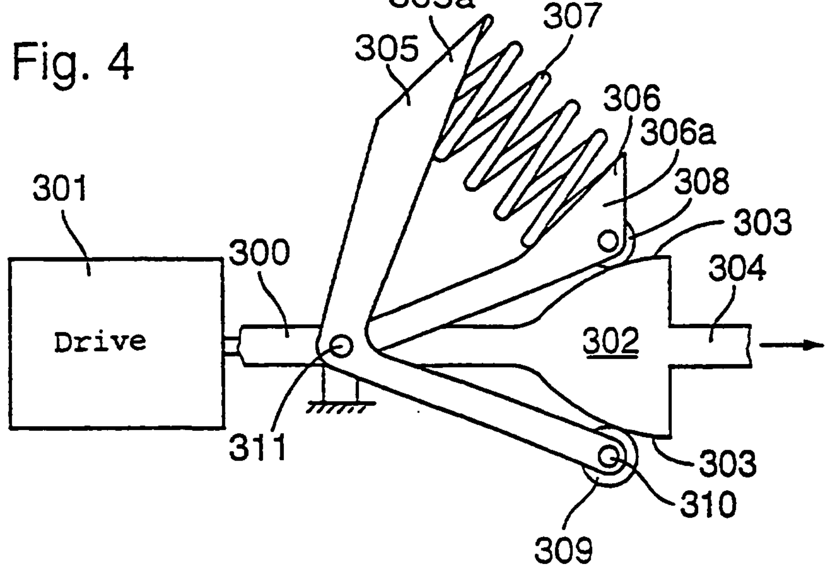


Fig. 4a

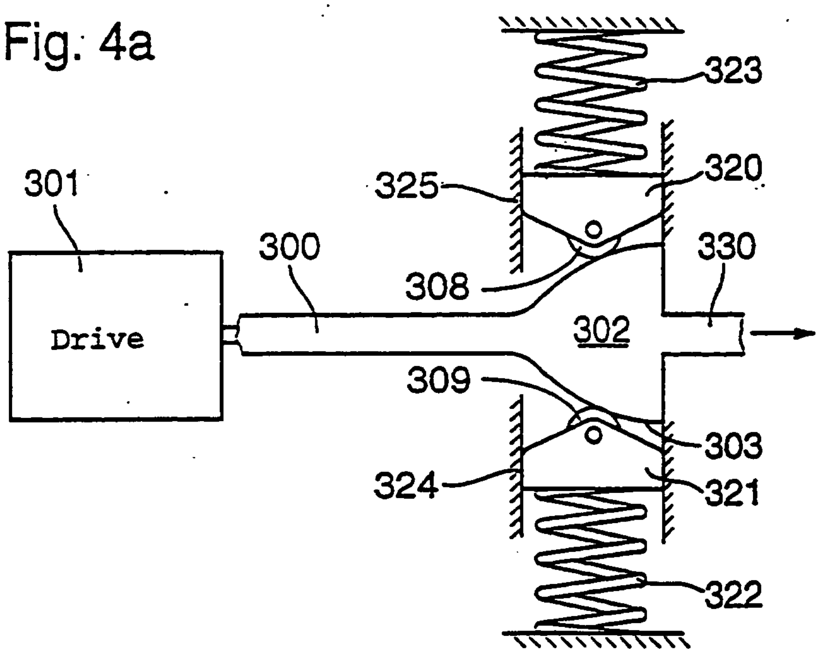


Fig. 4b

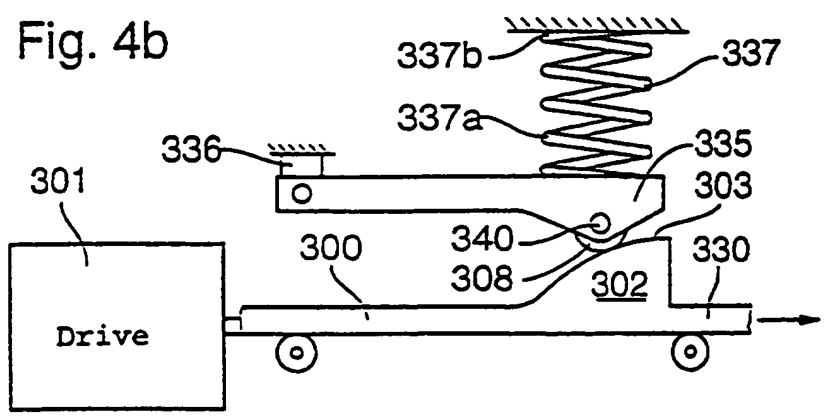
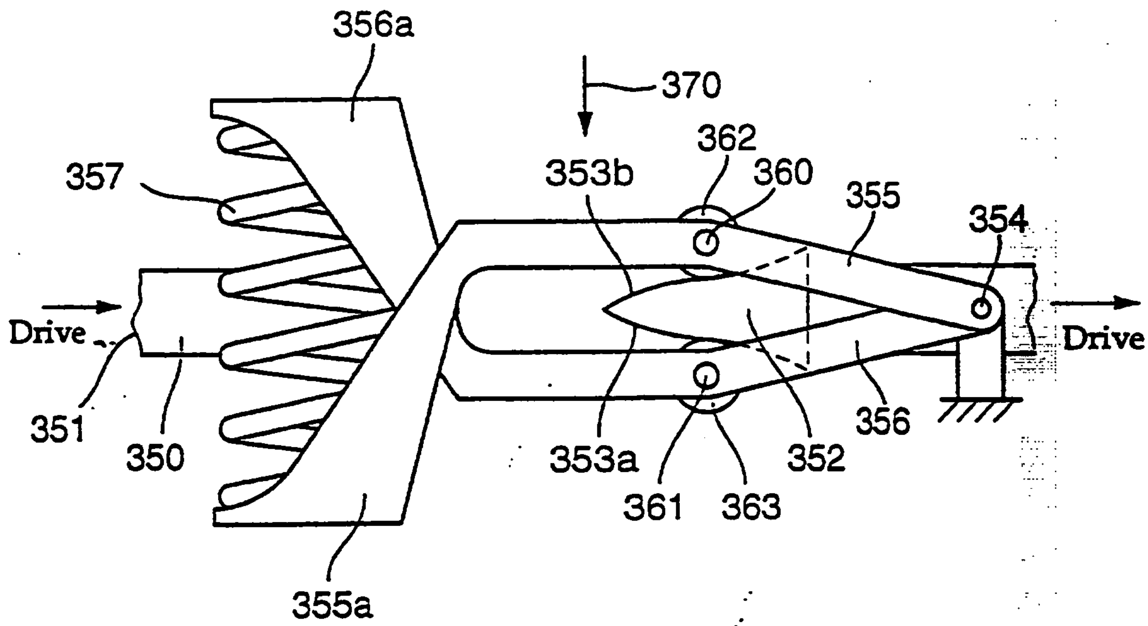


Fig. 5a


356a
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353b
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Drive
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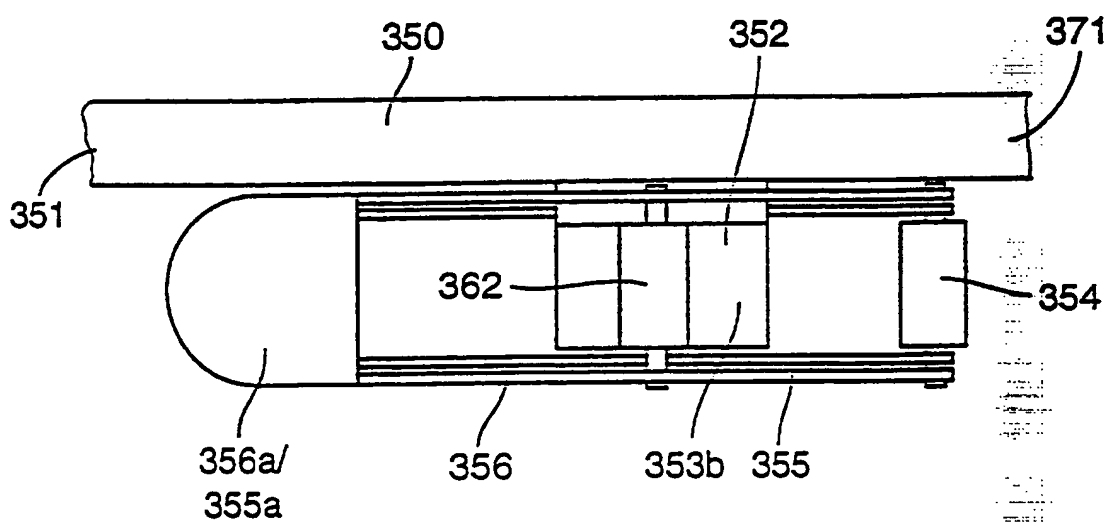
363
355a

Fig. 5b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356a/
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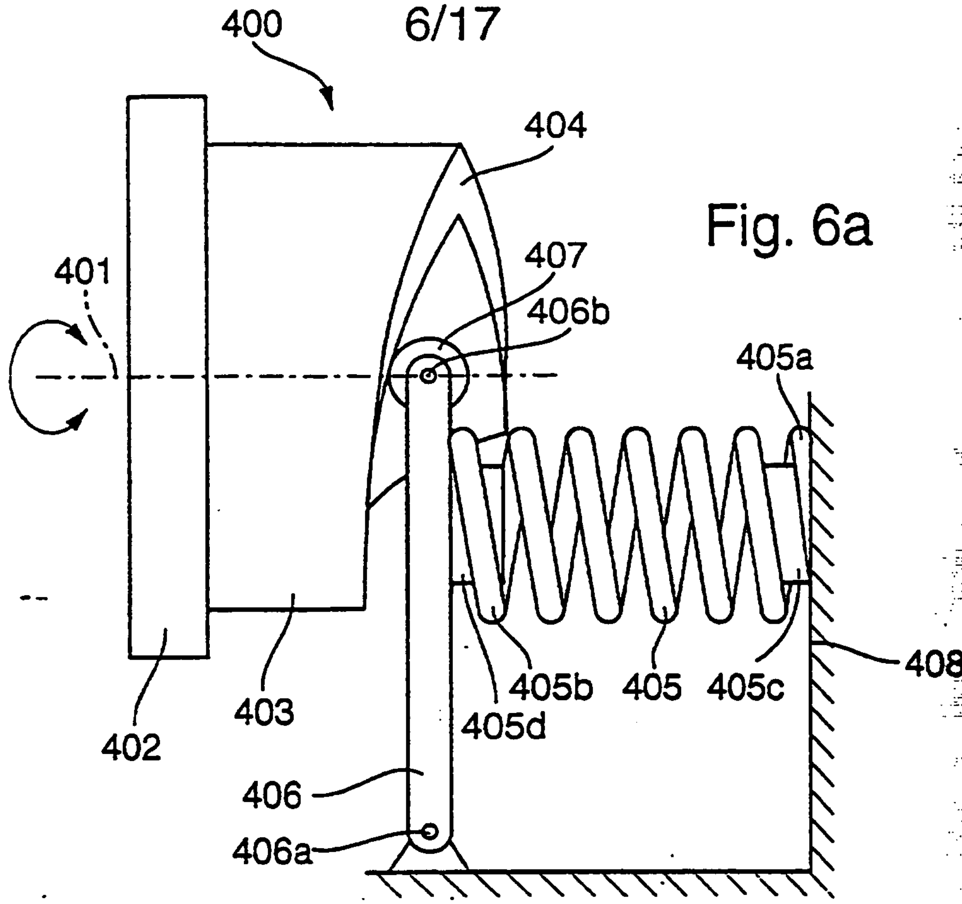

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406b
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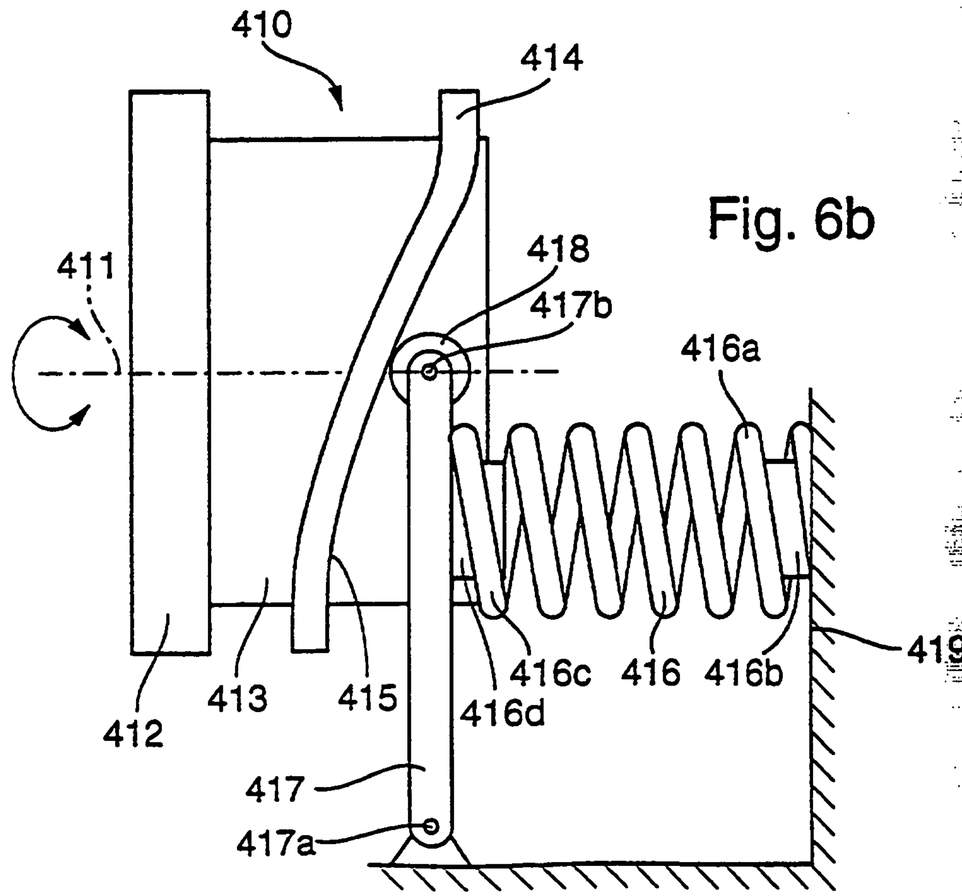
406a

Fig. 6a



410
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416c
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416b
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Fig. 6b

Fig. 6c

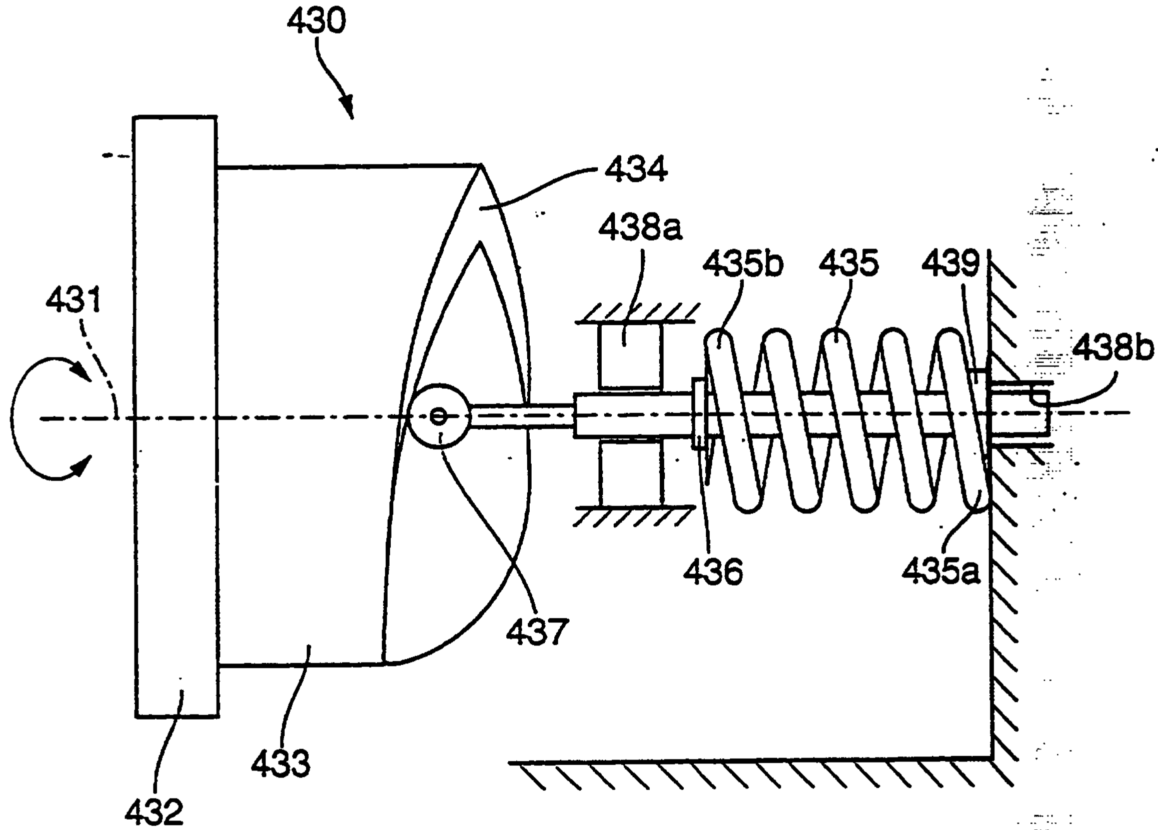
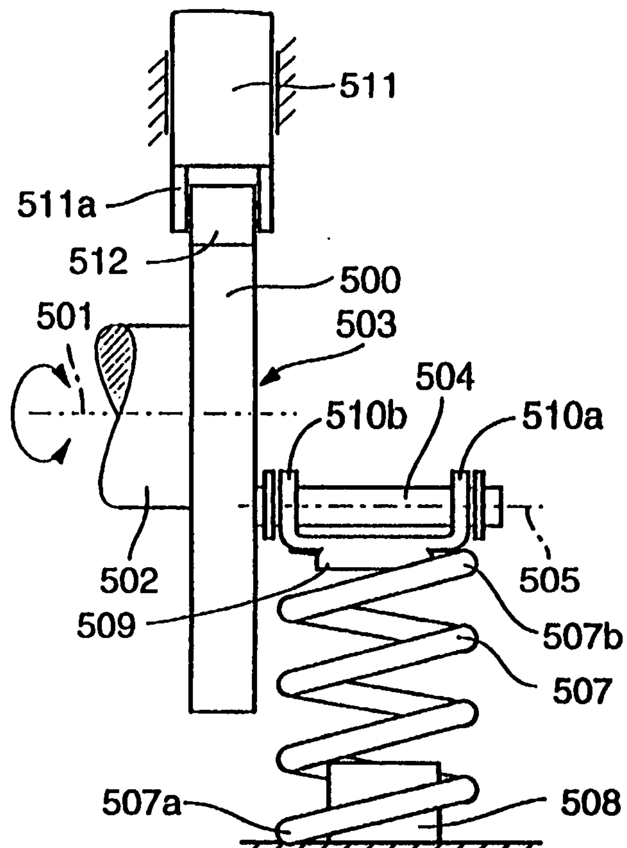


Fig. 7a



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511a
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Fig. 7b

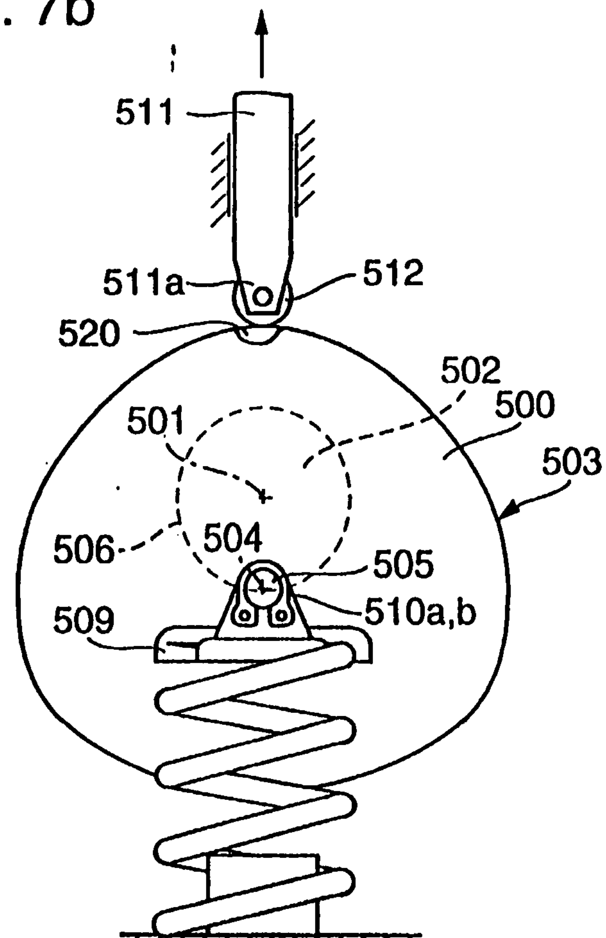

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Fig. 8a

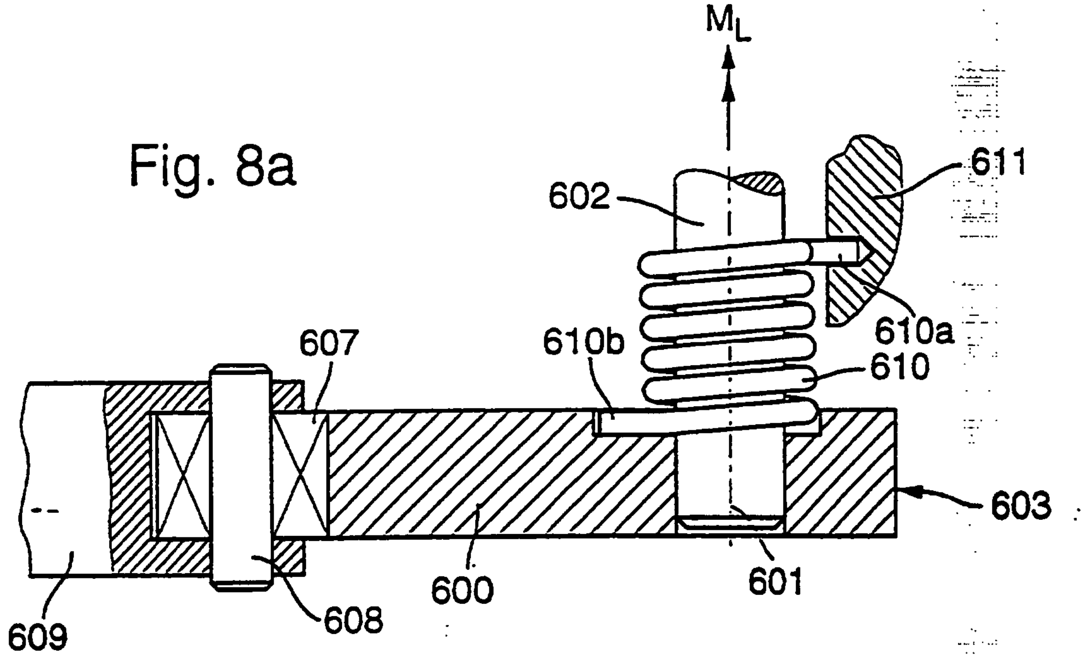

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Fig. 8b

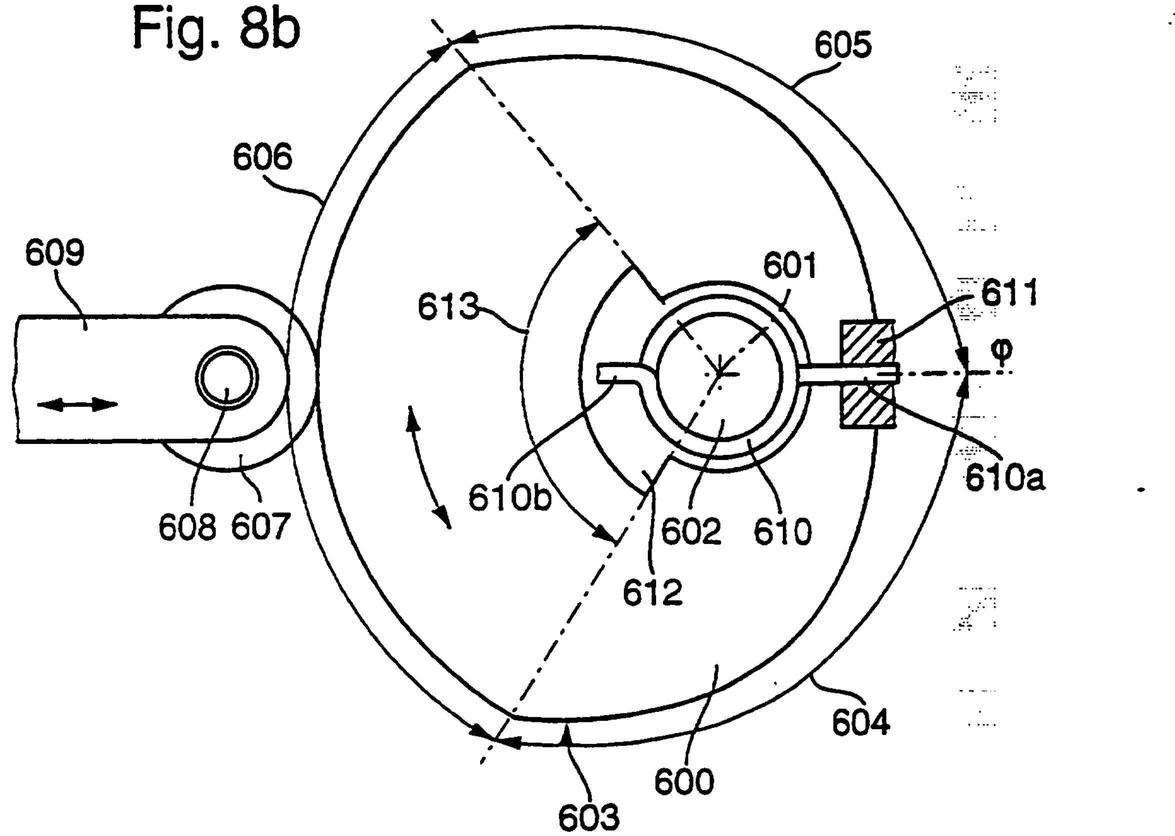

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Fig. 9

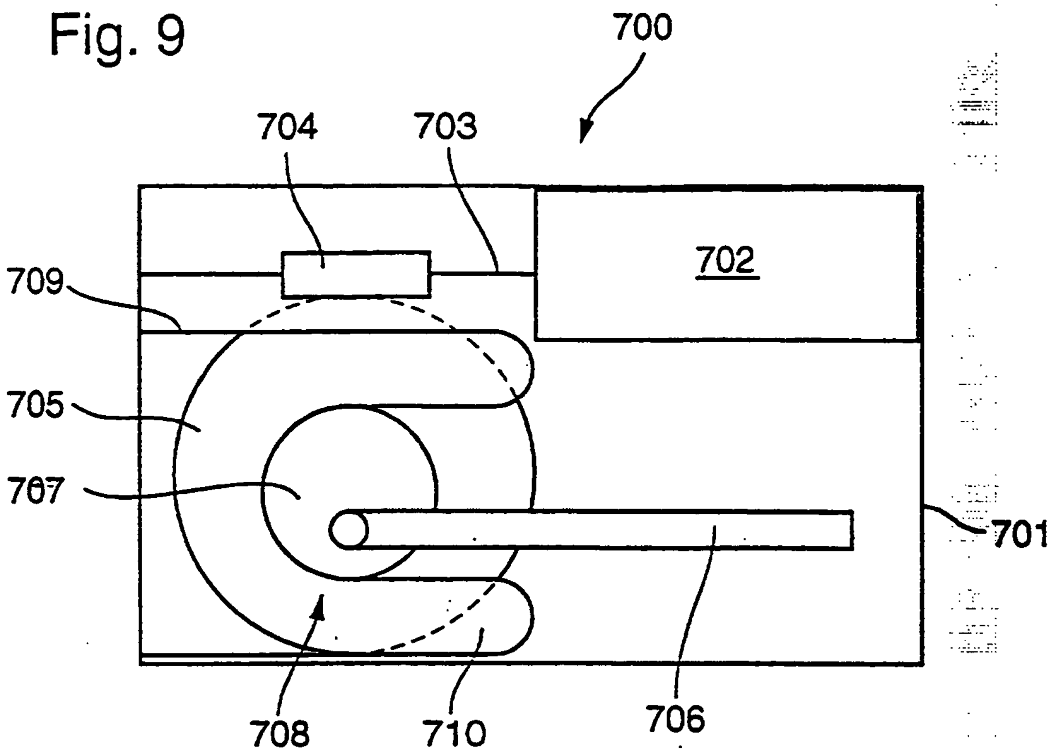
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Fig. 10

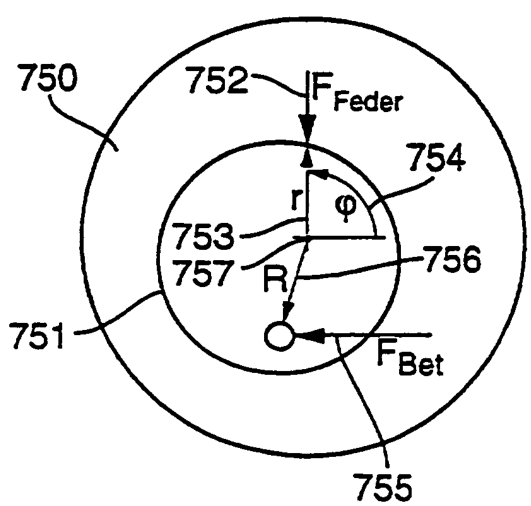
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Fig. 11

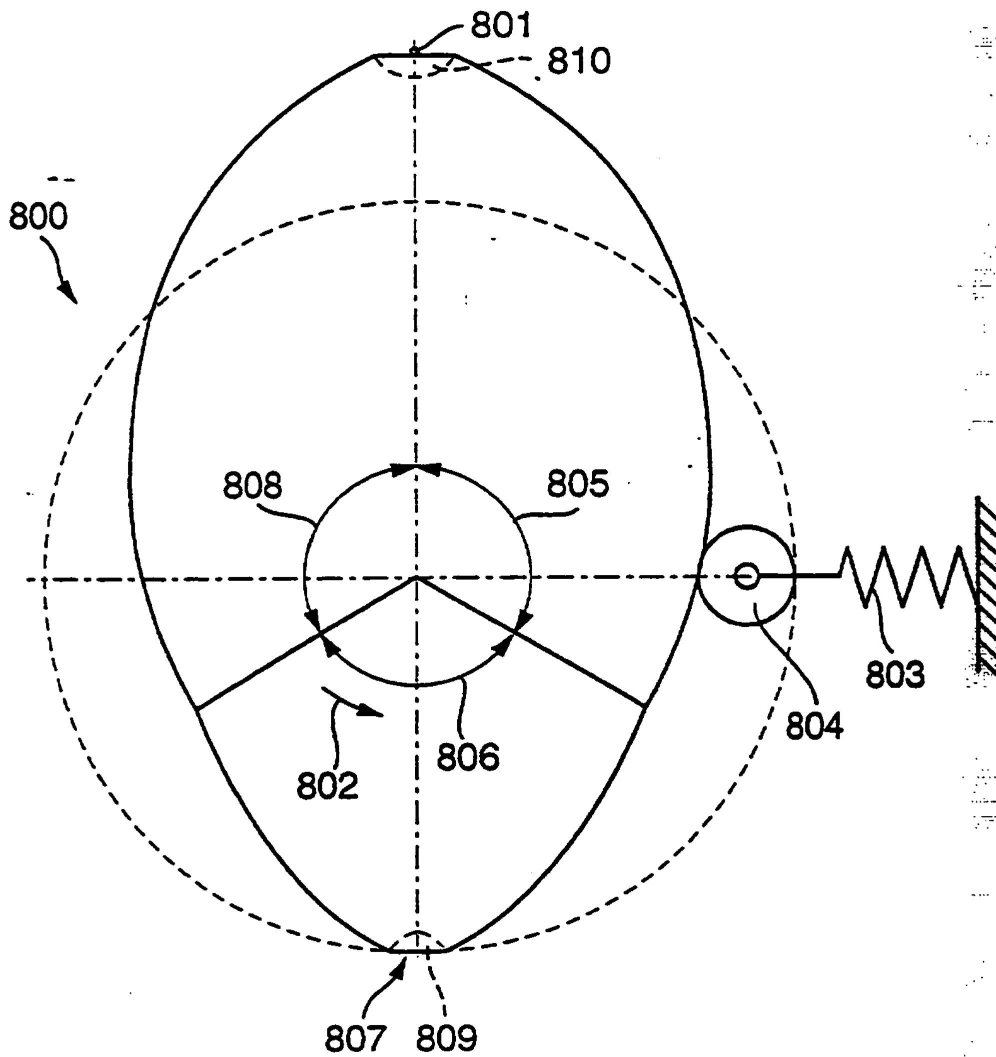
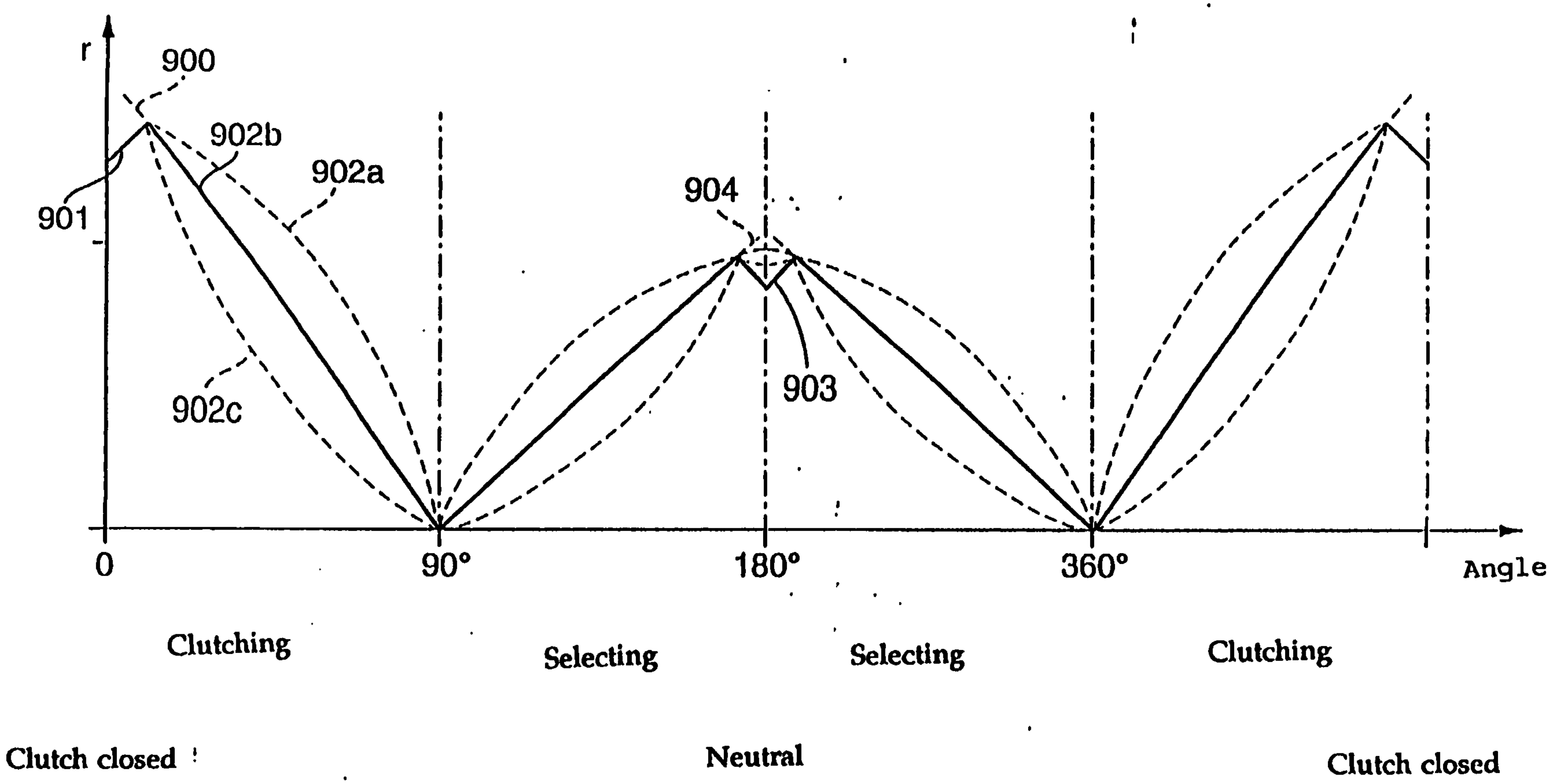


Fig. 12


r
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Neutral
Clutch closed

Fig. 13

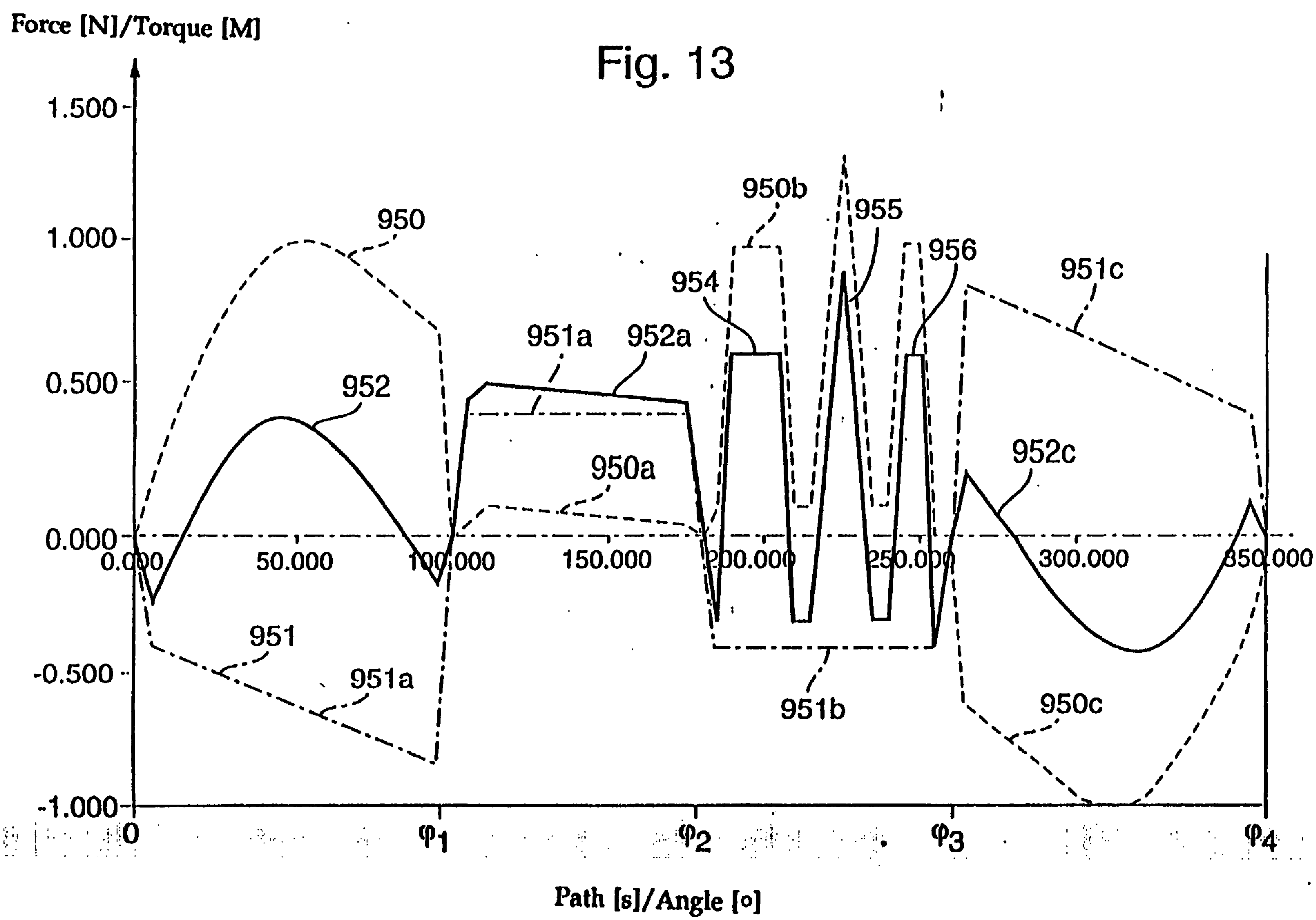
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Fig. 14

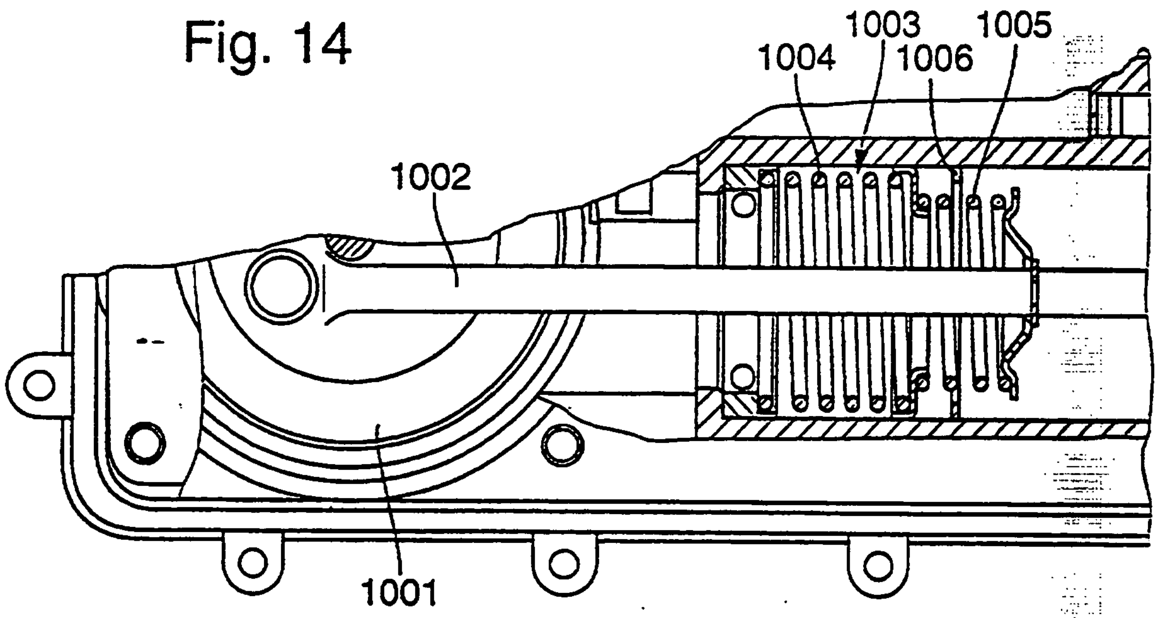


Fig. 14a

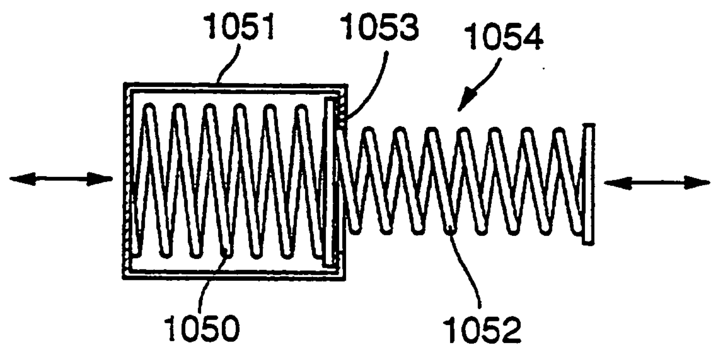


Fig. 14b

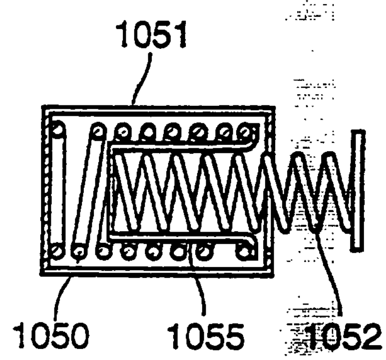


Fig. 15a

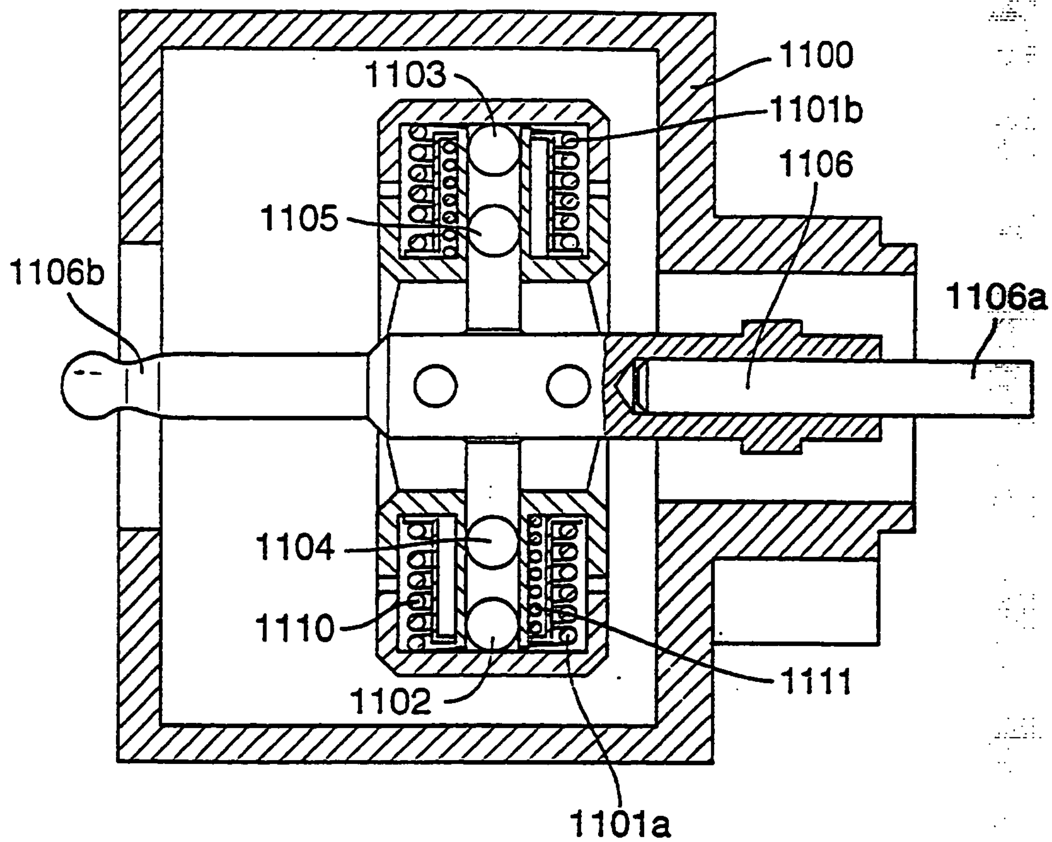


Fig. 15b

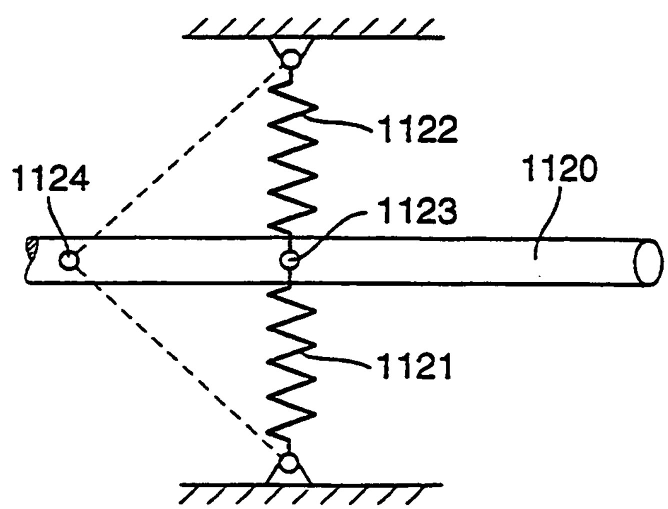
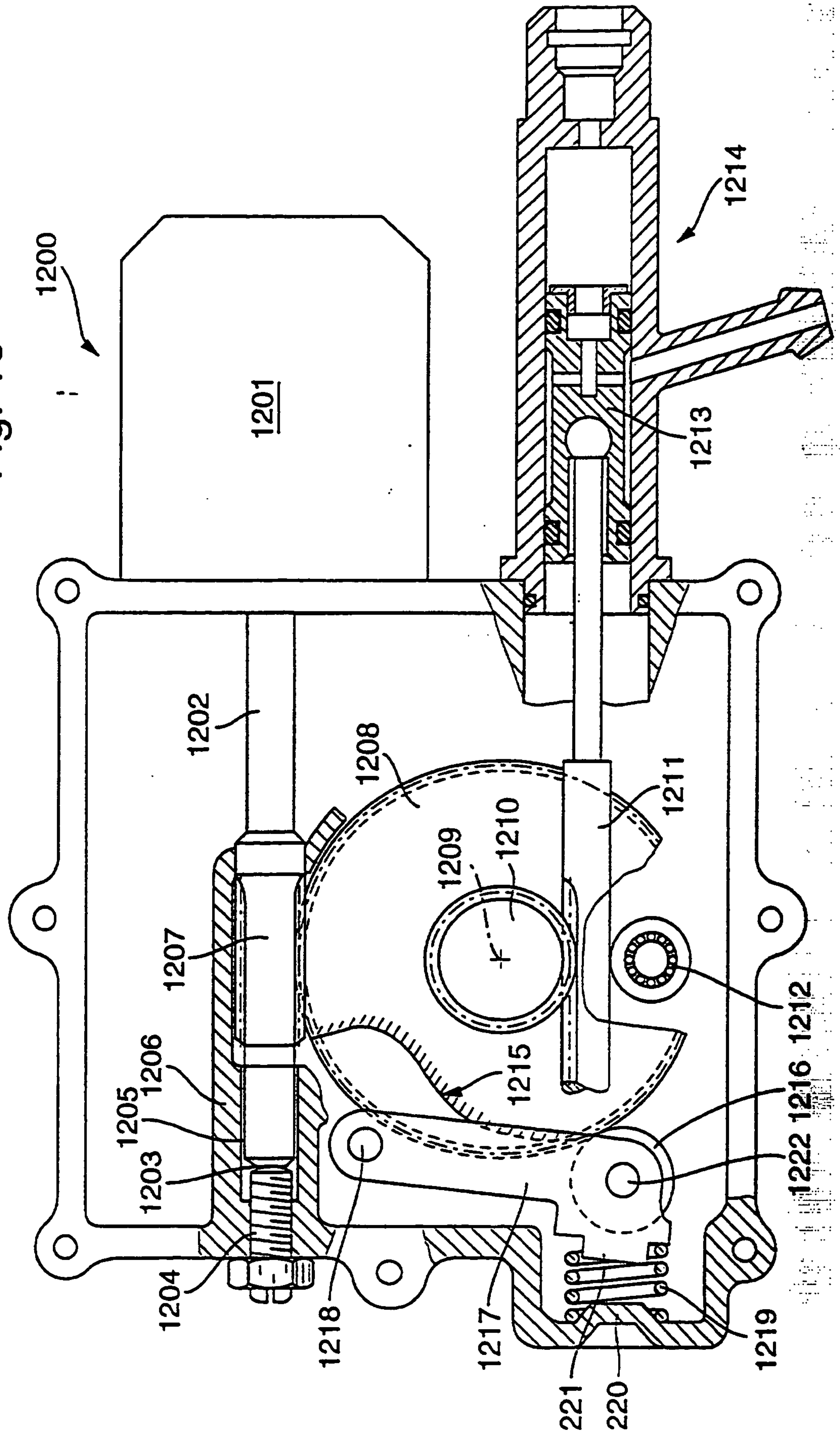


Fig. 16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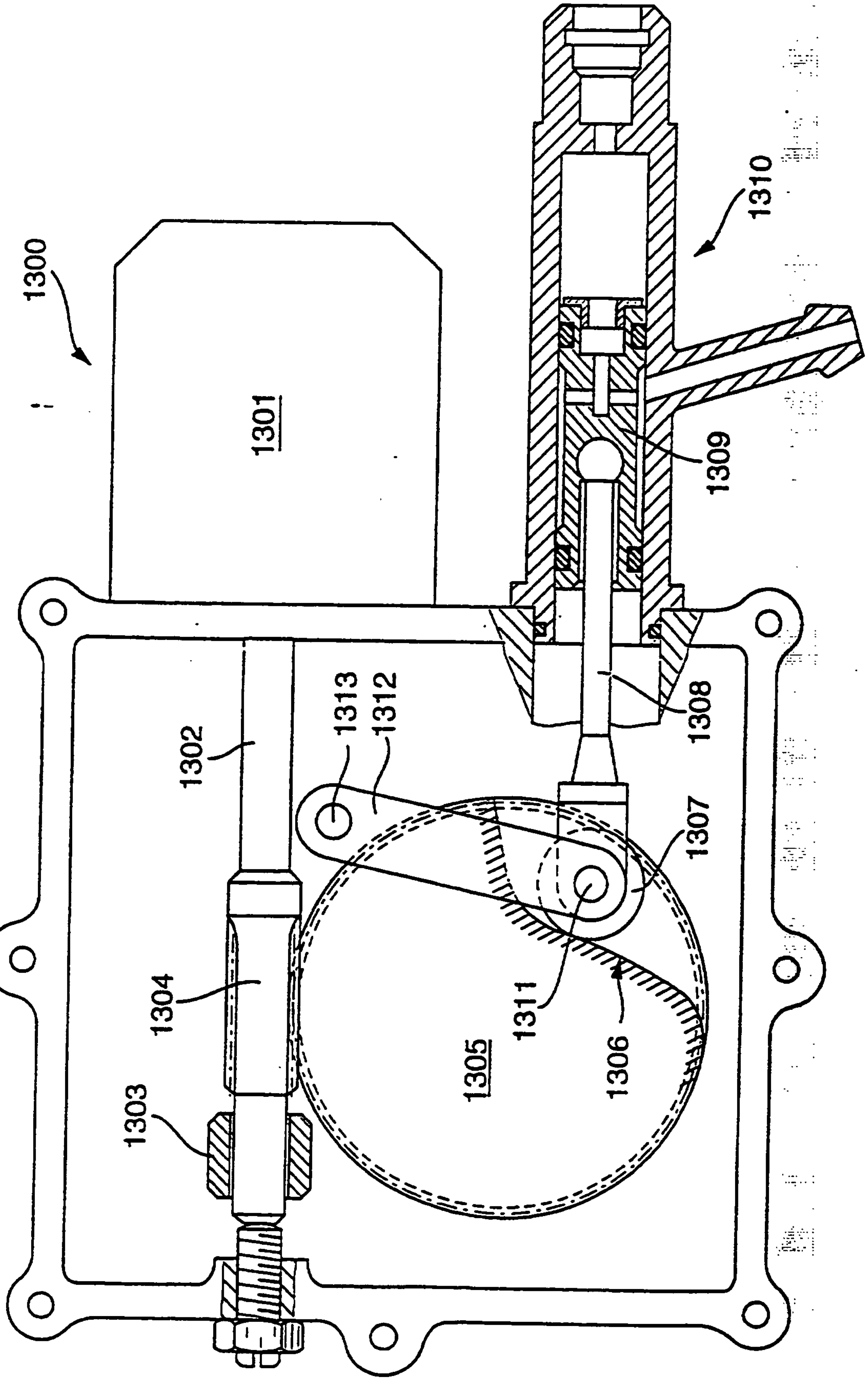
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Fig. 17

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OPERATING DEVICE

The invention relates to an operating device for controlling an operable control element such as for example a gearbox or a torque transfer system in the drive train of a motor vehicle, with a drive unit and an output element in active connection with same through a drive connection, with at least one energy accumulator by means of which a direct or indirect force action on the output element can be achieved.

Operating devices of this kind are known from DE OS 195 04 847. With these operating devices for torque transfer systems an operating device is shown which has an energy accumulator for force support wherein the energy accumulator is arranged linearly acting so that a linear operating path/force relationship is provided.

The object of the present invention is to provide an operating device of the kind mentioned above which has modulated force path, such as for example path-modulated force path which has force support acting on the output element which produces force support of a drive motor in at least one operating direction. Furthermore the object of the invention is to provide a device of the kind mentioned above which can be constructed more favourably with regard to structural space, costs and material outlay. The object of the invention is also to provide a device which has an improved functioning.

This is achieved with operating devices of the kind mentioned above according to the invention in that a force-biasable element with a three-dimensionally geometric contour, such as for example with a curved profile or with a cam disc or with a cam, is arranged in active connection with the drive connection and the force action of the at least one energy accumulator acts on the output element

through the three-dimensionally geometric contour of the element.

Furthermore according to the invention with an operating device for controlling an operable control element, for example for shifting or selecting the transmission ratio of a gearing or for operating a torque transfer system in the drive train of a motor vehicle, the operating device has a drive unit, where applicable a gearbox as well as an output element in active connection therewith through a drive connection, with at least one energy accumulator biasing the output element, it is advantageous if a force-biasable element with a three-dimensionally geometric contour, such as for example with a cam disc, a curved profile and/or with a cam, is mounted in the drive connection between the drive unit and the output element and the force action of the at least one energy accumulator acts on the output element through the three-dimensionally geometric contour.

Further it is advantageous if the force-biasable element with a three-dimensionally geometric contour, such as with a cam disc, with a curved profile or with a cam is biased by the at least one energy accumulator in the area of the three-dimensionally geometric contour, so that a force transfer to the output element takes place starting from the energy accumulator via the three-dimensionally geometric contour.

With a further development of the invention it is advantageous if the force-biasable element with the three dimensionally geometric contour such as cam disc, curved profile, cam path or cam is an element which is set in movement when the operable control element is operated.

With an operating device it is expedient if a force modulation of the force action from the energy accumulator

onto the output element takes place in the event of a force biasing of the force-biasable contour and a movement of the element with the force-biasable contour.

Furthermore it is expedient if the element with the force-biasable contour carries out a movement in at least one direction when the control element is activated.

It is likewise expedient if the element with the force-biasable contour is movable in the linear direction and/or in a circular movement and/or in an axial and/or in a radial direction and/or in the circumferential direction.

According to a further idea according to the invention it is expedient if the three-dimensionally geometric force-biasable contour of the element is aligned in the linear direction and/or in the axial and/or in the radial direction and/or in the circumferential direction.

With an embodiment according to the invention it is expedient if the force action of the at least one energy accumulator on the three-dimensionally geometric force-biasable contour of the element is directed substantially linearly and/or axially and/or radially and/or circumferentially.

Furthermore it is expedient if the modulation of the three-dimensionally geometric force-biasable contour of the element is aligned substantially linearly and/or axially and/or radially and/or circumferentially.

It is advantageous if with a force biasing of the contour through for example the at least one energy accumulator a force action takes place at least substantially in the direction of the output element or in the opposite direction.

Furthermore it is expedient if with a force biasing of the contour through for example the at least one energy accumulator the force action is split up at least substantially in the direction of an operating movement of the output element and/or into a direction at right angles to the operating movement.

Likewise it is advantageous if a gearing is arranged active in the drive connection between the drive unit and the output element.

It is expedient if the three dimensionally geometric element with the force biasable contour is in active connection with the drive unit, an element in the drive connection, or with the output element.

Furthermore it is expedient if the element with the three dimnesinally geometric force biasable contour has a one or two dimensional rotatable cam disc, cam path or a cam. Furthermore it is expedient if the element with the three dimensionally geometric force biasable contour has a one or two dimensional linearly or axially displaceable cam disc, cam path or cam.

According to the inventive idea it is advantageous if the element with the three dimensionally geometric force biasable contour has a three dimensional cam disc, cam path or cam.

It is likewise advantageous if the at least one energy accumulator which force biases the three dimensionally geometric contour has a slide shoe, roller and/or rolling bearing on which the energy accumulator is supported on the contour.

Furthermore the invention is advantageously designed so that

the at least one energy accumulator biases an element, such as for example lever, which is mounted movable in a first area and in a second area has a slide shoe, a roller or rolling bearing which biases the contour of the three dimensionally geometric element.

Furthermore it is expedient if the least one energy accumulator biases an element which is mounted by means of a linear guide and furthermore has the contour of the three dimensionally geometric element.

It is thereby advantageous if the at least one energy accumulator biases a gripper-like element which is mounted movable in an area and biases the contour of the three dimensionally geometric element.

It is advantageous if the at least one energy accumulator biases the element with the three dimensionally geometric contour for example in the area of a bearing point, such as on a non-centrally arranged stud wherein the output element is supported in the area of the three dimensionally geometric contour.

It is likewise expedient if the at least one energy accumulator biases the element with the three dimensionally geometric contour for example in the area of a bearing point such as on a non-centrally mounted stud wherein an element biasing the output element is supported in the area of the three dimensionally geometric contour.

Furthermore it is advantageous if the support on the three dimensionally geometric contour and/or the biasing of the three dimensionally geometrical contour takes place through sliding or rolling.

According to the inventive idea it is expedient if the drive

unit is an electric motor, an electromagnetic or electromechanical unit.

It is likewise expedient if the drive unit is a pressurised medium operated drive unit such as a hydraulic, hydropneumatic or pneumatic drive unit.

Furthermore it is expedient if a force action of the output element modulated through the operating path of the output element takes place on the output element of the operating device as a result of movement of the three dimensionally geometric contour and the force biasing of this contour.

It is likewise advantageous if the force support is provided at least over a partial area of the operating path of the output element.

With a further embodiment of the invention it is advantageous that the force support undergoes where applicable a change of sign during the course of the operating path.

According to a further inventive idea it is advantageous with an operating device for controlling an operable control element, more particularly for shifting and/or selecting the transmission ratio of a gearbox and/or for operating a torque transfer system in the drive train of a motor vehicle, the operating device has a drive unit and where applicable a gearbox as well as an output element in active connection therewith through a drive connection for operation, with at least one energy accumulator which can bias the output element, if the force action of the at least one energy accumulator acts on the output element wherein the at least one energy accumulator is mounted to act as a from-dead-point spring.

It is thereby particularly advantageous if two energy accumulators are arranged opposite one another and each bias the output element as a from-dead-point spring.

It is likewise advantageous if the at least one energy accumulator is arranged as a from-dead-point spring so that a first end area is swivel mounted on the output element and the second end area is swivel mounted for example on the housing.

With a further design according to the invention it is expedient if for controlling an operable control element, for example for shifting and/or selecting the transmission ratio of a gearbox and/or for operating a torque transfer system, in the drive train of a motor vehicle, the operating device has a drive unit and where applicable a gearbox as well as an output element in active connection therewith through a drive connection for operation, with at least two energy accumulators biasing the output element, the force action of the at least two energy accumulators acts on the output element wherein the two energy accumulators are arranged as energy accumulators connected in series.

Furthermore it is expedient if at least one energy accumulator is a pretensioned energy accumulator.

Furthermore it is expedient if the at least one energy accumulator is a spring, such as compression spring, leaf spring, loop spring or an elastic element of metal, rubber-like material or of plastics.

It is likewise expedient if the element with the three-dimensionally geometric contour is of metal or plastics.

It is advantageous if the element with the three-dimensionally geometric contour is formed integral with a

gear component.

It is likewise expedient if the element with the three-dimensionally geometric contour is formed integral with the output element.

In a further variation of the invention it is expedient if the element with the three-dimensionally geometric contour is formed integral with an element in the active connection between the drive unit and the output element.

It is furthermore expedient if the element with the three-dimensionally geometric contour is connected to an element in the active connection between the drive unit and the output element.

Embodiments of the invention will now be explained in further detail with reference to the drawings in which:

Figure 1	shows an operating device;
Figure 2	shows an operating device;
Figure 3	shows an operating device;
Figure 4	shows a compensation device;
Figure 4a	shows a compensation device;
Figure 4b	shows a compensation device;
Figure 5a	shows a compensation device;
Figure 5b	shows a compensation device;
Figure 6a	shows a compensation device;
Figure 6b	shows a compensation device;
Figure 6c	shows a compensation device;
Figure 7a	shows a compensation device;
Figure 7b	shows a compensation device;
Figure 8a	shows a compensation device;
Figure 8b	shows a compensation device;
Figure 9	shows an operating device;
Figure 10	shows a cam disc;
Figure 11	shows a cam disc;

Figure 12	shows a diagram;
Figure 13	shows a diagram;
Figure 14	shows a section of an operating device;
Figure 14a	shows an arrangement of energy accumulators;
Figure 14b	shows an arrangement of energy accumulators;
Figure 15a	shows an arrangement of energy accumulators;
Figure 15b	shows an arrangement of energy accumulators;
Figure 16	shows an operating device and
Figure 17	shows an operating device;

Figure 1 shows an operating device for the automated operation of for example a torque transfer system 2 and/or for the automated shifting of the gears of a gearbox in the drive train of a motor vehicle with a drive motor, a torque transfer system and a gearbox. The torque transfer system can be automatically engaged or disengaged by means of this device through a control unit or the torque transferable by the torque transfer system can be deliberately controlled. The gearbox can be a manual or automatic shift transmission wherein with an automatic gearbox the gear stages can be deliberately engaged, changed or released by means of the device. The gear stages can be controlled sequentially or in any sequence in dependence on the kinematics of the device.

The operating device 1 for the automatic operation of a torque transfer system and/or a gearbox has a drive unit 3 which can be formed for example as an electric motor. The drive unit of the operating deice can also be provided as an electromagnetic unit or as a pressurised-medium-operated unit, such as hydraulic or pneumatic unit.

The embodiment of Figure 1 shows a housing 4 of the operating device 1 in which the electric motor 3 is housed wherein the motor output shaft 5 is mounted at 6, 6a and 7. The electric motor 3 can also be fitted from outside on the housing 4 wherein in this case the motor output shaft 5 engages through an opening in the housing 4 into the latter. The pole housing 3a of the electric motor 3 is connected to the housing 4 of the device such as by screws, rivets or by means of a push-in connection. The motor output shaft projects in this case for example into the housing so that a drive connection is produced.

A gearbox can be mounted after the motor output shaft so that the drive movement such as rotary movement of the output shaft of the electric motor can be converted into for example a different type of movement. The embodiment of Figure 1 has a worm gearing on the output side as well as a crank gearing on the output side.

Preferably in the area between the two bearings 6 and 7 a worm is in active connection with the motor output shaft 5 and is at least substantially rotationally secured with the motor output shaft 5. This worm is not shown in Figure 1 but it does form a part of a worm gearing. The worm meshes with a worm gear wheel 8.

Instead of the worm gearing it is also possible however to use other gearings, such as for example planetary gearing, spur wheel gearing, cone pulley gearing, gearing with threaded spindle or further gears.

The worm drives the worm gearwheel 8 which is mounted to rotate about the axis 9. Furthermore a crank rod 11 is in active connection through the stud 10 with the worm gear wheel which operates or biases a pressurised medium operated master cylinder piston 12 of the operating device.

The element, such as crank rod 11 can be in driving connection with a piston 12 of a pressurised medium master cylinder, such as hydraulic master cylinder 13 and can control through an axial displacement of the master cylinder piston 12 the axial position of a slave cylinder piston 14, a pressurised medium slave cylinder such as hydraulic slave cylinder 15. The pressurised medium path 12, 13, 14 can be formed as a hydraulic path or pneumatic path.

The connection between the crank rod 11 and the master cylinder piston 12 can be provided by means of a connection 16 which is formed in the manner of a ball joint or universal joint and furthermore is designed for example so that during assembly it is easier to fit together through snap connection.

The output part 17 of the hydraulic slave cylinder serves as an output part of the operating device wherein this acts in this embodiment on a disengagement fork 18 so that the axial position of a disengagement bearing 19 can be adjusted or operated in order deliberately to engage or disengage the clutch or to set a deliberately transferable torque.

The torque transfer system 2 is shown as a friction clutch with a pressure plate 20, clutch disc 21 and a plate spring 22 which is mounted on a flywheel 23 wherein the clutch cover is marked by 24. The disengagement bearing 19 during axial movement operates the plate spring 22 wherein the clutch is engaged or disengaged. The friction clutch can be a self-adjusting clutch which compensates wear. The torque transfer system can be a multi-plate clutch or a converter bridging clutch of a torque converter or any other type of clutch. The friction clutch can be a dry friction clutch or a friction clutch running wet in a fluid.

The gearbox of the vehicle can be formed as a manually

shifted gearbox or as an automatically shifting gearbox. The gearbox can furthermore be formed as an automatic gearbox, such as stepped automatic, or an infinitely adjustable gearbox such as infinitely adjustable belt-contact cone pulley gearbox.

The operating device can be used for engaging and/or disengaging a torque transfer system or for operating a transmission ratio change of a gearbox of the above kind.

The operation of the clutch by means of the disengagement fork 18 takes place against the force of the plate spring 22 as energy accumulator. The means for disengaging can also be for example a central disengagement member.

Inside the operating device 1 is at least one energy accumulator 25 which is supported by its one end on the component part 26 which in turn is supported on the housing part 27 wherein the other end of the energy accumulator is supported on the component part 28 which is connected axially fixed to the crank rod 11 through a security ring 29. Through this arrangement of the energy accumulator it is possible to provide a force support of the crank operated by the drive unit by means of the energy accumulator. The force action of the energy accumulator 25 acts against or with the energy accumulator of the clutch. The direction of the force action of the energy accumulator 25 on the crank rod or on an output element can be modulated over the operating path.

The energy accumulator 25 is arranged substantially coaxial with the axis of the crank rod 11 and supports the movement of the crank rod 11 in the disengagement direction and/or engagement direction of the torque transfer system. Through a suitably selected pretension of the energy accumulator 25, such as for example coil compression spring, it is possible

that the energy accumulator exerts through a part of the operating path of the component part 11 a force which produces the disengagement process and over a further part of the axial path exerts a force which counteracts the disengagement process. Thus a change of sign of the force action on the crank can be provided.

The operating device 1 has furthermore a three-dimensionally geometric element 30 supporting or having a curved profile and which is connected rotationally secured with the worm gearwheel 8. The connection of the element 30 with the worm gearwheel 8 can take place through a push-in connection which thus produces a rotationally secured connection, or through screws or rivets. Furthermore the element 30 can be formed integral with the worm gearwheel 11. The worm gearwheel 8 can advantageously be made as an injection moulded plastics part wherein the element 30 is formed in one piece with its curved profile in the injection moulding process or is injected onto the worm gearwheel. The component part can however also be made of metal.

The element 30 supporting a curved profile is force-biased in order to exert through the curved profile a force on an output element of the operating device. The modulation of the curve profile allows a modulation of the force biasing as a function of the operating path or of the operating movement. The energy accumulator 50 exerts its force action on the curved profile directly or indirectly such as for example by a lever with rollers.

The curved profile divides the force acting on the curved profile into a part in the direction of movement and a part at right angles to the direction of movement wherein the part of the force in the direction of movement produces a force support or force compensation.

Figure 2 shows an operating device 100 with a drive unit 101, such as electric motor, with a motor output shaft 102 and a gearbox on the output side, such as for example a worm gearing wherein the worm is not shown in Figure 2. The worm meshes with a worm gearwheel 103 which drives an output element 105 via a crank 104. The crank 104 is mounted in the area 106 wherein the worm gearwheel is mounted rotatable in the area 107.

The motor shaft 102 is mounted by means of the bearings 110 and 111.

A three-dimensionally geometric element 120 is connected rotationally secured with the worm gearwheel 103 wherein the element 120 has a contour 121, such as a curved profile or cam disc. A lever-like element 123 is swivel mounted in the area 122 wherein a roller 125 is rotatably mounted in the area 124 of the element 130. An energy accumulator 126 biases the lever 123 so that the roller 125 is biased against the contour or profile 121 of the element 120. The energy accumulator is mounted rotatable by protruding elements 130 and 131 so that it cannot slip wherein these are designed so that the elements 130 and 131 engage in the central axial opening of the energy accumulator such as compression spring. Through this engagement the energy accumulator is mounted substantially secure against displacement or secure against loss.

The force action which starts from the energy accumulator 126 and is transferred through the lever 123 and roller 125 to the contour 121 is divided at the engagement point according to the usual forces parallelogram into a part which acts in the radial direction and a part which acts in the circumferential direction. The force components in the radial direction act centrally on the axis 107. The part of the force in the circumferential direction causes a force

action on the crank 104 and thus on the output element 105. The force support thereby achieved or force compensation of the operating force acting on the output element 105 can be modulated through the curved profile 121 of the three-dimensionally geometrical element 120, such as cam disc or cam, as a function of the movement. The radially and circumferentially acting force components correspond to an action on a rotating cam disc. In general the force acting on the curved profile is divided into a part substantially parallel to the direction of movement or operation as well as into a part substantially at right angles to the direction of movement or operation.

Through the curve-controlled force action or compensation of the compensation spring it is possible to achieve a compensation force distribution or compensation movement which is substantially dependent on use.

In the example shown in the embodiment of Figure 2 a spring 126 is provided fixed on the housing and acting directly or indirectly through the lever 123 onto a curved profile 121 on the worm wheel 103. If the distance of the spring/curved profile contact point from the rotary axis 107 of the worm wheel changes then a moment is produced in the circumferential direction. The curved profile can be formed so that this acting moment counteracts or supports the moment produced by the operating force on the output element 105. With a curve-controlled compensation spring it is possible through the modulation of the curved profile to restrict the compensating action where applicable to individual areas of the adjustable path wherein this can be achieved in that over the turning angle of the curved profile 121 a change of the radius of the curved profile is only provided over partial areas of the angle. In other partial areas of the turning angle an unchanged radius can be provided.

The design of the curved profile allows a deliberate modulation of the force which is exerted or applied in the direction of the operating movement. The force action can thereby be matched for example so that it acts over the entire operating path in one direction or at least changes its sign once such as direction, over the operating path. Similarly the amount of the operating force can be modulated over the operating path.

By three-dimensionally geometric contour, such as for example cam disc or curved profile or modulated surface connected to a cam disc or to a cam, is understood by way of example a surface 121 according to Figure 2. The surface has a component in the axial direction and in the circumferential direction wherein the modulation of the surface or of the curved profile takes place through a modulation of the radius as a function of the turning angle. The force biasing takes place substantially in the radial direction so that a division of the force into a circumferential component and into a radial component is produced. The circumferential component of the force of the energy accumulator on the surface thus produces the advantageous force support of the drive. It is likewise advantageous if as shown in Figure 6a and 6b the surface has a component in the circumferential direction and in the radial direction and the modulation of the surface in the axial direction as a function of the turning angle so that an axially acting force is produced through a force split into a force component in the circumferential direction and in the axial direction so that the circumferential component of the force serves to support the drive. That which has been described above advantageously relates to drives with elements located in a circular movement. With devices having a linear movement of elements, such as for example with a device of Figure 4 to 5b it is advantageous if the surface of the three-dimensionally geometric contour, such

as for example with a curved profile or with a cam disc or with a cam, has a component in the radial direction and in the axial direction wherein the modulation of the surface takes place so that a distance of the radius from the axis of the movement is modulated as a function of the axial direction. A force action thereby occurs on for example a rod linkage in the direction of the movement wherein a force split is produced through the surface of the curved profile.

Figure 3 shows an embodiment according to Figure 2 wherein the energy accumulator 200 is provided as a leaf spring like element which is fixed by fixing means 201 on the housing 202. A roller 205 is mounted rotatable in the area of the bearing 204 on the arm 203 of the energy accumulator 200 whereby this energy accumulator biases the roller 205 against the curved profile 206 of the three dimensionally geometric element 207. The curved path or the curved profile of the contour 206 of the element 207 is modulated in the radial direction when the element 207 is rotated in the circumferential direction. A force modulation can thereby be achieved which causes a force support or force compensation on the element such as output element 210.

Figure 4 shows a cut out section of a force compensation device of an operating device wherein a force action is transferred starting from an energy accumulator via a curved profile to an output element. The force compensation device can produce force compensation or force support in relation to the output element, depending on the direction of the applied force.

The force compensation device has an axially displaceable element 300 which is driven by a drive unit 301 for example with electric motor and gearbox. The axially displaceable element 300 has in the area 302 a contour or curved profile 303 which viewed in the axial direction has a modulated

circumference, radius or distance. The element 304 is further connected to an operable element wherein the force support of the element 302 acts as a force support to operate the operable element. The force biasing of the modulated areas 303 is carried out so that a first angled lever 305 is swivel mounted in the area 311 and a second lever 306 is likewise mounted in area 311 wherein an energy accumulator 307 is mounted between the receiving areas 305a and 306a to bias same with pressure.

A roller 308 is mounted rotatable in the area 305a. In the end area of the lever 305 a further roller 309 is mounted rotatable in the area of the rotary axis 310. Through the force biasing of the energy accumulator 307 in the areas 305a and 306a the rollers 308 and 309 are biased on the modulated path 303 of the element 302 so that a force-biasing support action of the energy accumulator is produced on the element 302 and element 304. A force support or force compensation of the force required for operation is attained over the curved path or the modulation of the area 302, 303.

Figure 4a shows diagrammatically a drive 301 which drives the element 300 for example through a gearbox. The element 300 has an area 302 which has a curved path or a curved profile 303. The curved profile is biased by a roller 308, 309 wherein this roller is mounted rotatable in the front area of a slide shoe 320, 321. The energy accumulators 322, 323 are housed in one end area by the slide shoes wherein they are supported fixed relative to the housing at a second end area. The slide shoes 320, 321 are mounted for sliding movement through slide guides 324, 325. The force biasing of the curved profile 303 is provided by the energy accumulators through the rollers 308, 309 so that a force action is produced on the element 302 and the output part 330 of the element 300. A path-dependent force biasing of

the element 303 is reached through the modulation of the curved profile 303 as a function of the axial extension of the element 300.

Figure 4b shows a further embodiment wherein a drive 303 biases the element 300 drive-wise for example by means of an electric motor and gearing wherein the element 300 has a curved profile 303 in the area 302. Furthermore the element 300 has a biasing area 330 on the output side which operates an operating element for controlling a torque transfer system or gearing. The biasing of the curved profile 303 of the element 302 is produced by the biasing of a swivel mounted lever arm 335 which is swivel mounted in the area 336 wherein the bearing fixing is secured relative to the housing. The lever arm 335 is biased by the energy accumulator 337 which is in active connection with the lever arm at its end area wherein this end area is designated 337a and is mounted fixed on the housing at its other end area 337b. Through the force biasing the roller 308 which is mounted rotatable in the area 340 is biased against the curved profile 303 so that a force action takes place from the energy accumulator via the lever arm and roller onto the curved profile and onto the output element 330.

Figure 5a shows an element 350 which is axially displaceable and is controllable such as drivable in the area 351 by a drive unit. An element 352 is connected such as formed integral or fixed to the element 350. The element 352 has a modulated support surface 353a, 353b. The lever arms 355 and 356 are mounted for rotary such as swivel movement in the area 354, a rotary axis, wherein the lever arms 355 and 356 have receiving areas 355a and 356a which hold an energy accumulator 357 so that the energy accumulators bias the elements 355 and 356 towards each other. Rollers 362 and 363 are mounted in the receiving socket areas 360 and 361 and the element 352 is mounted between the rollers. The rollers

362 and 363 roll on the contour 353a, 353b whereby through the force biasing of the energy accumulator in the area of the receiving areas of the lever a force biasing of the rollers is produced opposite the contour 353a, 353b which biases the element 352. A force action is thereby transferred from the energy accumulator 357 through the lever arms and rollers onto the curved path and from the curved path 353a, 353b onto the element 352 and from there to the element 350.

Figure 5b shows the arrangement of Figure 5a in plan view according to the arrow 370 of Figure 5a. This shows the element 350 which can engage in the area 351 and in area 371 operates an operable element. Also shown are the receiving socket areas 326a, 355a as well as the lever arms 355 and 356. Furthermore the roller 360 can be seen which biases the surface 353b, the element 352.

Figure 6a shows a cut out section of a device for operating a torque transfer system or a gearing (400) wherein an element 402 is mounted to rotate about an axis 401 and can rotate about the axis 401 and is drivable by a drive unit. The element 402 can be for example the worm wheel 8 of Figure 1 or another drivable element, such as for example gearwheel. An element 403 supporting a curved profile 404 is fixed with the drivable element 402 whereby the curved profile is also connected or formed direct with the element 402. The curved profile 402 of the element 403 is axially modulated whereby viewed in the circumferential direction the axial distance of the modulated surface 404 varies.

The energy accumulator 405 is fixed on the housing side at one end 405a wherein a stud 405c projects into the core area of the energy accumulator and thus holds the energy accumulator locally fixed. The end area 405b of the energy accumulator is connected by a receiving area 405d to a lever

406 so that the force action of the energy accumulator 405 is transferred through the lever 406 and roller 407 to the curved face or cam disc 404 and from there to the output element 402. The lever 406 is mounted rotatable in the area 406a wherein the roller 407 is mounted rotatable in the area 406b. The force action of the energy accumulator 405 is transferred through the lever 406 and roller 407 substantially in the axial direction to the curved profile 404 wherein a force action takes place circumferentially onto the element 402. The arrangement of Figure 6a thus produces a supporting force which acts circumferentially relative to the axis 401.

Figure 6b shows an arrangement 410 for force support or force compensation of a device for operating a torque transfer system or a gearbox wherein the element 412 is mounted rotatable about the axis 411 wherein the element 412 can be driven and turned for example by a drive unit. The element 412 can be formed for example as a worm gear wheel such as is marked by reference 8 for example in Figure 1. The element 413 is connected to or formed integral with the element 412 wherein the element 413 is a substantially cylindrical element which has on its outer circumference a curved profile such as an axially modulated edge. The curved profile 414 can be formed integral with the cylindrical element 413. The energy accumulator 416 is mounted at one end 416a by retaining means 416b securely fixed on the housing 419 and at its other end 416c is mounted by retaining means 416d engaging on a lever. The lever 417 is swivel mounted in the area 417a wherein in area 417b a roller 418 is mounted which is axially supported in the area of the curved face 415 of the curved profile 414 and transfers a force action of the energy accumulator onto the element 412. The force action takes place axially starting from the energy accumulator 416 wherein a translation of the force action takes place in the

circumferential direction of the element 412 through the biasing of the curved profile.

Figure 6c shows an element for force compensation or force reduction of force support of a device for operating a torque transfer system or gearbox wherein an element 432 is arranged coaxial with an axis 431 and can be set in rotation and driven by a drive unit. The substantially cylindrical shaped element 433 is connected to or formed integral with the element 432 wherein the element 433 supports a curved profile 434. The energy accumulator 435 is connected fixed to the housing on one side 435a by the retaining means 439 wherein a plunger 436 is biased in the area 435b and is linearly guided by the guides 438a and 438b. The plunger 436 has at its axial end area a roller or slide area which biases the curved path or cam disc 434 of the element 433 in order to transfer a force support from the energy accumulator 435 to the element 432. The guide 438a and 438b can be sliding or through a rolling bearing.

Figure 7a shows a rotatable element 500 which is mounted rotatable coaxial with the axis 501 and can be driven through the shaft 502 with a drive element or an interposed gearbox. The circumferential area 503 of the element 500 is modulated in the radial extension, viewed circumferentially, so that the circumferential area 503 as cam disc can guarantee a modulated control. The stud 504 is connected, such as fixed, to the element 500 relative to the axis 505 wherein the stud 504 during rotation of the element 500 moves on a circular path 506. The energy accumulator 507 is mounted fixed on the housing by the retaining means 508 wherein the latter project in the end area 507a into the core area of the energy accumulator and thus prevent displacement or escape of the energy accumulator. The energy accumulator is housed in the end area 507b by retaining means 509 which have eyelets 510a and 510b which

by means of the stud 504 lead to a rotatable bearing of the element 509 such as socket area. When the energy accumulator is housed so that a pull and push force can be exerted on the energy accumulator or can emanate therefrom the force of the energy accumulator can now be supported by the stud on the element 500 wherein a change of sign and a quantity modulation of the force action of the energy accumulator on the element 500 can be carried out. The output element 511 is designed as a plunger which has in its end area 511a a rotatably mounted roller 512 which is supported on the edge area 503 of the element 500. A force compensation or modulation of the force action on the element 511 can be achieved through the rotary-angle-dependent force modulation of the force action of the energy accumulator on the element 500 and the rotary-angle-dependent radius modulation of the element 500.

The embodiment of Figures 7a and 7b shows a variation of a curve-controlled compensation spring and a from-dead-point or over-dead point spring on a plunger. The variation shows that on the one hand a spring is fixed eccentrically on a revolving disc and as a result of its pretension can produce a moment relative to the rotary point of the disc and on the other hand can cause a clutch operation through an attachment on a curved profile on the disc. In this case the disengagement force characteristic line can be matched by the shape of the curved profile as best possible to the compensation characteristic line of the compensation spring. The compensation characteristic line can have over wide operating areas a force path which comes very close to the disengagement force characteristic line of a clutch. The disengagement force produces a moment acting on the cam disc. The connection between the two values can be described as follows through a simplification of the friction freedom:

$$M_{Last} = F_{Ausruck}\, dr/d\varphi = F_{Ausruck}\, ds_{Ausruck}\, /d\varphi$$

M_{Last} is thereby the moment caused by the disengagement force, r the distance from the contact point of the force action from the cam disc to the plunger for clutch activation, as well as φ the turning angle of the cam disc. Changes to r correspond to changes in the case of the operating path $S_{Ausruck}$.

If with the clutch activation a counter force is produced then energy is released from the compensation force on the revolving disc. With a reversed operation, that is during movements of the plunger in the force direction the energy supplied back from the clutch spring can again be stored in the spring which can lead to a relaxation of the drive element, such as the electric motor.

As a further development areas 520 can also be provided on the edge of the cam disc which lead to a detent since for support the roller of the plunger 511 passes into an area 520 provided therefor which requires an increased force to emerge from this area.

Figure 8a shows an arrangement for the force compensation or force support with a device for operating a torque transfer system and/or gearbox wherein the substantially disc shaped element 600 is mounted rotatable about the axis 601. The element 600 is driven through the drive shaft, such as drive connection 602 so that a rotary movement of the element 600 deliberately takes place. The circumference of the element 600 is designed as a radius-modulated cam disc which has in a first angular area 604 and in a second angular area 605 a radius which varies with the turning angle and in a where applicable further angular area 606 has a constant radius.

A roller 607 is supported on the marginal area 603 which is

similar to a cam disc whereby the roller is mounted rotatable in the area of the plunger 609 by means of the bearing point 608 so that the drive connection is transferred from the element 602 through the element 600 and roller 607 to the plunger 609. An axial movement of the element 609 takes place through the rotation of the element 600 and modulation of the radius to operate a torque transfer system and/or to select or shift a gearing.

For force support an energy accumulator 610 such as a loop spring is mounted so that one end of the loop spring 610a is fixed relative to the housing such as for example engages in a retaining area of the housing 611. The other end area of the loop spring 610b is connectable in keyed engagement with the element 600. The keyed connection can be formed so that it takes place in any position or angular position of the element 600 or however so that a freewheel angle is provided in which the energy accumulator is not biased during rotation of the element 600. The area 612 as shown in Figure 8b is formed as a freewheel area of this kind, this means that the indentation 612 in which the end 610b of the loop spring 610 is housed provides force biasing of the spring only after overcoming a free angle.

This angular area 613 corresponds for example to the angular area in which the radius modulation is zero, that is the angle at 613 corresponds in Figure 8b to the angular area 606.

A device according to Figures 8a and 8b can be used for example for force compensation by means of a compensation spring for clutch activation with a cam disc which is driven for example by an electromotorized drive. This is advantageous with an automated operation of the coupling and operation process of the gearing with two electromotorized actors. Thereby one actor executes the function parts

coupling and shifting, and the second actor executes the function part selecting. Furthermore other splits of the coupling, shifting and selecting of a gear can also be undertaken wherein the selecting process is the operating process of the gear between the shift gates and the shift process is the operation of the gear within the shift gates. For a comfortable disengagement and engagement of the torque transfer system an automated clutch ought to be able to be opened and deliberately closed quickly wherein the opening of the clutch can be carried out more quickly or more slowly in dependence on the operating state and the closing of the clutch ought likewise to be carried out more quickly or more slowly in dependence on the operating state of the vehicle or the operating parameters.

The load for the actor is as a rule greatest when opening the clutch since when closing the clutch the energy stored in the disengagement spring of the clutch becomes free. The disengagement spring of the clutch is for example the plate spring in the case of a plate spring clutch. Since the operating time rises with the actor load it is expedient if the actor can be supported by an additional energy accumulator during opening of the clutch.

With the electromotorized actor for example for the functions coupling and shifting it is possible to drive for example through a self-locking gearbox a cam disc which is divided into three areas.

In the first area, for example in the angular area 605 the clutch is opened and in the second area the clutch is kept open such as for example in the angular area 606, and in the third area the clutch is again closed, such as for example in angular area 604. For a cam disc with a linearly increasing or decreasing stroke or an increasing or decreasing stroke according to another deliberately selected

function of the turning angle or of the path a drive moment is required which is proportional to the clutch characteristic line.

In combination with a linearly acting compensation spring the load moment is at first negative during opening of the clutch. A linearly acting compensation spring of this kind for controlling the torque transfer system is shown for example by reference numeral 25 in Figure 1. As a result of the self-locking gearbox of the actor the spring cannot or not strongly enough accelerate the actor so that the actor in this case can run load-free or substantially load-free. In the second area of the cam discs in which the actor operates the shift the clutch is kept opened. The compensation spring thereby runs without force in its free wheel area. In the third area in which the clutch is closed the energy stored in the disengagement spring of the clutch is released so that the load moment at first becomes negative. As a result of the self-locking of the actor or actor gearing the actor runs in this case substantially load-free. With about 2/3 of the entire disengagement path the operating force is practicably nil. In this area the clutch is frequently operated in order to control the transferable moment which is the case for example in various operating states, such as engagement or disengagement before or after shift processes or in control situations with moment matching.

Moment matching is in this connection a control of the transferable torque transfer system using the torque available on the drive side which is dependent on the ensuing engine moment minus the moments of the secondary consumers such as for example climate control.

Since the operation in such an area is practically without force the actor can set the transferable clutch moment

rapidly and with low energy take-up. However other operating characteristic lines can also be produced with the curved profile 603 of the cam disc 600. Up to a complete closing of the clutch the actor must work against the compensation spring until this is tensioned again. The cam disc can also be formed as a curved profile on the circumference or on the end side of a cylinder. Instead of a cam disc however it is possible to use any other types of non-uniformly translating gearboxes with detent or movement phases. The compensation spring can be fixed in the housing with attachment on the cam disc but can also be fixed on the cam disc with attachment in the housing.

Fitting a torsion spring such as a loop spring which is active during opening and closing of the clutch by means of a cam disc is an expedient embodiment of the invention. During closing of the clutch the compensation spring is loaded up, the energy stored in the disengagement spring is moved into the pretension of the compensation spring. During opening of the clutch the compensation spring is to compress or bias the disengagement spring. In the turning angle area of the cam disc in which the actor carries out the shift or for example carries out a selection process the clutch is held open and the compensation spring is relaxed and is not attached or biased.

Figure 9 shows diagrammatically an actor 700 with a housing 701 in which the drive unit 702 such as electric motor is housed or flanged on from outside. The motor output shaft 703 is connected through a worm 704 to a worm wheel 705 in order to operate the output element 706 such as for example a plunger or crank. For force compensation a cam disc 707 with modulated surface 708 is connected rotationally secured to the worm wheel 705 whereby at least one energy accumulator 709, 710 force biases the cam disc 707. A modulation of the force biasing by the energy accumulator on

the output element 706 is reached through the modulation of the cam disc or curved path 708.

Figure 10 once again shows this state wherein the circular contour 750 represents the outer radius of the worm gear wheel for example 705. The contour 751 corresponds to the contour of the cam disc 708.

The arrow 752 represents the force action of the energy accumulator which acts from the energy accumulator onto the cam disc 751. The radius r 753 represents the distance from the centre point of the worm wheel 750 and the angle φ 754 corresponds to the turning angle. The arrow 755 corresponds to the operating force which acts on the output element and the radius R756 corresponds to the distance of the engagement point of the operating force from the turning point 757. The compensation action of the compensation spring which acts according to arrow 752 on the cam disc is thus produced as:

$$M_{komp} = dr/d\varphi * F_{feder} .$$

As a variation the energy accumulator which applies the force 752 can be formed as a bending spring or leaf spring or as a spring acting through a lever.

Figure 11 shows a design of a cam disc 800 which is used in an actor for the combined operation of a clutch and gearbox. With a turn of 360°, a disengagement process, a shift process and a coupling process of the clutch is carried out. Starting from the point 801 where the clutch is closed the cam disc is automatically operated in the direction of arrow 802 in order to achieve a force modulation as a function of the operating path or of the operating angle. At the beginning of the operation with the clutch closed the energy accumulator 803 engages by its roller 804 in the area 801

and biases the cam disc.

In the angle area 805 the clutch is disengaged, in the angle area 806 a shift process is operated wherein in the first angle half a gear is disengaged wherein at point 807 neutral is reached and in the second angle half of the angle area 806 a further gear is engaged before in the angle area 808 the clutch is engaged again. The cut-out section 809 and 810 respectively can be used to fix the neutral area or the closed clutch.

Figure 12 shows a radius modulation R as a function of the angle of a cam disc according to Figure 11. With the angle 0° the radius is maximum or substantially maximum wherein according to the curve 900 or 901 a maximum exists or a minimum according to a detent. From angle 0° to angle 90° the radius modulation can decrease according to curves 902a, 902b or 902c wherein at 90° a minimum is reached. From 90° to 180° the radius modulation rises again wherein the transition in the area of 180° can be guided through a detent minimum 903 or through a maximum 904 before a minimum is reached at angle position 270°. From 270° to 360° the radius modulation rises again. In the area from 0° to 90° a coupling process takes place wherein at 0° the clutch is closed and at substantially 90° the clutch is opened. From 90° to 180° a shift process takes place wherein at 180° neutral is reached and from 180° to 270° a shift process takes place before from 270° to 360° the clutch is closed again.

Figure 13 shows the action of the compensation on the coupling and shift forces or moments. The curve 950 corresponds in the first $\varphi 1$ of the disengagement force characteristic line as well as from $\varphi 1$ to $\varphi 2$ of the characteristic line for disengaging the gear corresponding to 950a and in the angular area from $\varphi 2$ to $\varphi 3$ corresponding

to the path 950b to an engagement process of a gear and in the angular area from φ3 to φ4 corresponding to 950c of a coupling process. The curved path of the curve 951 corresponds to the force or moment of the compensation wherein the compensation in area 951a is negative, with φ equal to φ1 undergoes a change of sign to the positive, in the angular area from φ2 to φ3 according to 951b is negative and at φ3 again undergoes a change of sign as well as in angular area from φ3 to φ4 according to 951c is positive. The solid line 952 is the resulting force, and the resulting moment respectively as a sum of the coupling and shifting forces 950 and compensation forces 951. This shows a clear overall reduction of the maximum values in relation to the pure coupling and shifting forces 950. In the angular area from 0° to 1° a reduced coupling force is seen wherein in the angular area from φ1 to φ2 a force rise takes place up to the curved path 952a before in the angular area φ2 to φ3 a reduction of the shift forces take place. The maximum which is shown at 954 occurs through synchronization and unlocking processes wherein the maximum which is marked by 955 occurs through the tracking process during shifting and the force maximum 956 arises through running into a stop in the gearbox. In the angular area φ3 to φ4 the engagement force characteristic line is reduced quantity wise from 950c to the curved path 952c. Overall a reduction is reached of the quantity values of the coupling and shifting forces.

Figure 14 shows a cut-out section of an actor according to Figure 1 with a worm wheel 1001, an element such as a crank 1002 and an energy accumulator 1003. The energy accumulator 1002 has as opposed to the energy accumulator 25 of Figure 1 a series connection of two energy accumulators 1004 and 1005 wherein a two-stage characteristic line is reached in that the energy accumulator 1004, such as spring, is a softer spring than the energy accumulator 1005. The element 1006 serves as a stop for pretensioning. Through the

arrangement of energy accumulators of different stiffness it is possible to reach a multi-stage characteristic line of the compensation force action.

Figures 14a and 14b show embodiments for arrangements of two energy accumulators wherein an arrangement of more than two energy accumulators can be advantageous for forming a multi-stage characteristic line. The energy accumulator 1050 is housed in a holder 1051 wherein the energy accumulator 1050 can be under pretension. The energy accumulator acts through the element 1053 on the pretensionable energy accumulator 1050 wherein with an axial biasing of the element 1054 first the energy accumulator 1052 is biased and deformed until the force action of the pretension is overcome and then also the energy accumulator 1050 is compressed.

Figure 14b shows an embodiment where the element 1055 between the energy accumulators 1050 and 1052 has a pot-shaped design so that the axial structural space can be better utilized if the operating path is sufficiently small and allows such a structural shape. In cases with a larger axial operating path an embodiment according to Figure 14a is advantageous.

The element 1051 is formed as a pot-shaped element and the element 1055 has an at least pot-shaped cross-section. The pretensionable springs of Figures 14a and 14b can have a lower spring stiffness than the non-pretensioned spring.

Figure 15 shows an embodiment of a compensation spring assembly for a device for operating a torque transfer system and/or gearbox wherein inside a housing 1100 is at least one spring assembly 1101a, 1101b which on the one hand is mounted fixed relative to the housing but able to swivel through a swivel bearing 1102, 1103 and is swivel connected

to an output element 1106 through a further connection 1104, 1105. The element 1106 is connected on the drive side in the area 1106a so that an axial movement of the element can take place wherein on the output side the part 1106b biases an output element for operation. Through the axial displacement of the element 1106 the articulation points 1104 and 1105 are displaced in the axial direction wherein the articulation points 1102 and 1103 remain locally fixed so that a relative movement of the elements biasing the energy accumulators 1110 and 1111 takes place and a force action is exerted in the axial direction through the energy accumulator on the element 1106. The energy accumulators 1110 and 1111 are arranged so that they exert at least in one position, such as end position, a force action only in a direction perpendicular to the axis of movement of the element 1106. With a displacement of the element 1106 however a force component of the force action from the springs to the element 1106 acts in the direction of movement of the element 1106. The force action can however also act in the opposite direction wherein a proportion points in the direction of the axis of movement. A diagrammatic illustration of this behaviour is shown in Figure 15b wherein the element 1120 is mounted movable wherein energy accumulators 1121 and 1122 are arranged both on the side of the housing and on the element 1120 and for example are under pretension in the end area corresponding to the illustration of the springs 1120 and 1121. With an activation of the element 1120 in the axial direction the suspension point 1123 is moved in the axial direction up to the point 1124 so that a force action of the energy accumulators 1121 and 112 also acts in the axial direction. The arrangement of the energy accumulators can be selected so that in the end area a dead point is reached so that the energy accumulators do not act as over-dead point springs. Furthermore it can also be advantageous if the energy accumulators act as over-dead point springs wherein an axial

force thereby acts in the end point of the operation. This axial force is not present if the springs are in the dead point at the end of the operating path.

Figure 16 shows an operating device 1200 with a drive unit 1201 such as electric motor. The electric motor 1201 drives a motor shaft 1202 which is supported axially in the area 1203 by means of the element 1204. Furthermore the shaft 1202 is mounted in the area 1203 through an opening or guide 1205 in the housing wall 1206. The worm 1207 is connected rotationally secured with the shaft 1202. The worm 1207 meshes with the worm wheel 1208 which is mounted in the area of the axis 1209. The worm wheel 1208 is associated with a gearwheel 1210 or this is formed in one piece with the worm wheel. The teeth of the gear wheel 1210 drive a toothed rod 1211 which controls a piston 1213 of a pressurised medium master cylinder 1214 such as a hydraulic master cylinder. The toothed rod 1211 is supported by the roller 1212 or bearing in the radial direction of the gearwheel 1210.

The worm wheel 1208 or a disc connected therewith, such as for example also the gearwheel 1210 has a curved profile which is biased directly or indirectly by an energy accumulator 1219. The energy accumulator 1219 is mounted between a receiving area in the housing 1206 and a receiving area on a lever 1217 wherein the lever 1217 is mounted rotatable in the area of the bearing 1218. Furthermore the lever has a socket for a roller 1216 which is mounted rotatable in the area 1222. The roller rolls on the contour of the curved profile 1215 and thus biases the curved profile and through this and through the design of the curved profile produces a path-dependent or position-dependent force on the output element of the device. A receiving area 1220 is provided on the housing 1206 and a receiving area 1221 is provided on the lever 1217 which engages in the end areas of the energy accumulator, such as

coil compression spring in order to fix the energy accumulator substantially in its position and/or to produce safeguard against loss.

Figure 17 shows a further advantageous embodiment of an operating device 1300 according to the invention. The device 1300 has a drive unit 1301 which can be formed as an electric motor. The electric motor 1301 drives a shaft, such as engine shaft 1302 which is mounted in the area 1303 by means of a slide or rolling bearing. A worm 1304 is connected substantially rotationally secured to the shaft 1302 and meshes with a worm gearwheel 1305. The worm wheel 1305 has a contour or curved profile 1306 on which a sliding or rotating element is supported, such as a roller 1307 or for example a slide shoe. The roller 1307 is mounted on the lever or on the crank 1308 and this is mounted on the piston 1309 or the pressurised medium slave cylinder 1310 such as hydraulic cylinder. The roller 1307 is mounted rotatable in the area of the bearing 1311. Furthermore a lever 1312 is attached for articulated movement in the area of the bearing 1311 and on the other side is attached for articulated movement likewise in the area 1313. The lever arm 1313 guides the movement of the push rod 1308 during biasing of the rotable contour 1306, during turning of the gearwheel 1305. A path modulation of the master cylinder piston can thereby be achieved as a function of the turning movement of the wormwheel or generally as a function of the operating movement.

The embodiments of Figures 16 and 17 show variations where the motor axis, such as shaft is preferably arranged parallel to the axis of the crank or plunger of the output element. Furthermore the worm wheel can form a plane with the motor shaft wherein the crank or plunger can be in this plane or outside of this plane.

The present invention furthermore relates to the prior application DE 19622641 whose contents belong expressly to the disclosure of the present application.

The patent claims filed with the application are proposed wordings without prejudice for achieving wider patent protection. The applicant retains the right to claim further features disclosed up until now only in the description and/or drawings.

References used in the sub-claims refer to the further design of the subject of the main claim through the features of each sub-claim; they are not to be understood as dispensing with obtaining an independent subject protection for the features of the sub-claims referred to.

The subjects of these sub-claims however also form independent inventions which have a configuration independent of the subjects of the preceding sub-claims.

The invention is not restricted to the embodiment of the description. Rather numerous modifications and alterations are possible within the framework of the invention, more particularly those variations, elements and combinations and/or materials which are inventive for example through combination or modification of individual features or elements or method steps contained in the drawings and described in connection with those in the general description and embodiments and claims and lead through combinable features to a new subject or to new method steps or sequence of method steps where they relate to manufacturing, testing and work processes.

PATENT CLAIMS

1. Operating device for controlling an operable control element for example for shifting and/or selecting the transmission ratio of a gearbox and/or for operating a torque transfer system, in the drive train of a motor vehicle, the operating device having a drive unit and where applicable a gearbox, as well as an output element in active connection therewith through a drive connection for operation, with at least one energy accumulator which can bias the output element, characterised in that a force-biasable element with a three-dimensionally geometric contour, such as for example with a curved profile or with a cam disc or with a cam, is arranged in active connection with the drive connection and the force action of the at least one energy accumulator acts on the output element through the three-dimensionally geometric contour of the element.

2. Operating device for controlling an operable control element, for example for shifting or selecting the transmission ratio of a gearbox or for operating a torque transfer system in the drive train of a motor vehicle, the operating device has a drive unit, where applicable a gearbox as well as an output element in active connection therewith through a drive connection, with at least one energy accumulator biasing the output element, characterised in that a force-biasable element with a three-dimensionally geometric contour, such as for example with a cam disc, a curved profile and/or with a cam, is mounted in the drive connection between the drive unit and the output element and the force action of the at least one energy accumulator acts on the output element through the three-dimensionally geometric contour.

3. Operating device according to one of the preceding

claims, characterised in that the force-biasable element with a three-dimensionally geometric contour, such as with a cam disc, with a curved profile or with a cam is biased by the at least one energy accumulator in the area of the three-dimensionally geometric contour, so that a force transfer to the output element takes place starting from the energy accumulator via the three-dimensionally geometric contour.

4. Operating device according to one of the preceding claims, characterised in that the force-biasable element with the three-dimensionally geometric contour, such as cam disc, curved profile, curved path or cam is an element which is set in movement during operation of the operable control element.

5. Operating device according to one of the preceding claims, characterised in that a force modulation of the force action from the energy accumulator onto the output element takes place in the event of a force biasing of the force-biasable contour and a movement of the element with the force-biasable contour.

6. Operating device according to one of the preceding claims, characterised in that the element with the force-biasable contour carries out a movement in at least one direction when the control element is activated.

7. Operating device according to claim 6 characterised in that the element with the force-biasable contour is movable in the linear direction and/or in a circular movement and/or in an axial and/or in a radial direction and/or in the circumferential direction.

8. Operating device according to one of the preceding claims, characterised in that the three-dimensionally

geometric force-biasable contour of the element is aligned in the linear direction and/or in the axial and/or in the radial direction and/or in the circumferential direction.

9. Operating device according to one of the preceding claims, characterised in that the force action of the at least one energy accumulator on the three-dimensionally geometric force-biasable contour of the element is directed substantially linearly and/or axially and/or radially and/or circumferentially.

10. Operating device according to one of the preceding claims, characterised in that the modulation of the three-dimensionally geometric force-biasable contour of the element is aligned substantially linearly and/or axially and/or radially and/or circumferentially.

11. Operating device according to one of claims 6 to 10 characterised in that with a force biasing of the contour through for example the at least one energy accumulator a force action takes place at least substantially in the direction of the output element or in the opposite direction.

12, Operating device according to one of the preceding claims, characterised in that with a force biasing of the contour through for example the at least one energy accumulator the force action is split up at least substantially in the direction of an operating movement of the output element and/or into a direction at right angles to the operating movement.

13. Operating device according to one of the preceding claims, characterised in that a gearing is arranged active in the drive connection between the drive unit and the output element.

14. Operating device according to a preceding claim, characterised in that the three dimensionally geometric element with the force biasable contour is in active connection with the drive unit, an element in the drive connection or with the output element.

15. Operating device according to a preceding claim, characterised in that the element with the three-dimensionally geometric force-biasable contour has a one or two dimensional rotatable cam disc, cam path or a cam.

16. Operating device according to a preceding claim, characterised in that the element with the three-dimensionally geometric force-biasable contour has a one or two dimensional linearly or axially displaceable cam disc, cam path or cam.

17. Operating device according to a preceding claim, characterised in that the element with the three-dimensionally geometric force-biasable contour has a three-dimensional cam disc, cam path or cam.

18. Operating device according to one of the preceding claims, characterised in that the at least one energy accumulator which force biases the three-dimensionally geometric contour has a slide shoe, roller and/or rolling bearing on which the energy accumulator is supported on the contour.

19. Operating device according to one of the preceding claims, characterised in that the at least one energy accumulator biases an element, such as for example lever, which is mounted movable in a first area and in a second area has a slide shoe, a roller or rolling bearing which biases the contour of the three-dimensionally geometric element.

20. Operating device according to one of the preceding claims, characterised in that the at least one energy accumulator biases an element which is mounted by means of a linear guide and furthermore has the contour of the three-dimensionally geometric element.

21. Operating device according to one of the preceding claims, characterised in that the at least one energy accumulator biases a gripper-like element which is mounted movable in an area and biases the contour of the three-dimensionally geometric element.

22. Operating device according to one of the preceding claims, characterised in that the at least one energy accumulator biases the element with the three dimensionally geometric contour for example in the area of a bearing point, such as on a non-centrally arranged stud wherein the output element is supported in the area of the three-dimensionally geometric contour.

23. Operating device according to one of the preceding claims, characterised in that the at least one energy accumulator biases the element with the three dimensionally geometric contour for example in the area of a bearing point such as on a non-centrally mounted stud wherein an element biasing the output element is supported in the area of the three-dimensionally geometric contour.

24. Operating device according to one of the preceding claims, characterised in that the support on the three-dimensionally geometric contour and/or the biasing of the three-dimensionally geometrical contour takes place through sliding or rolling.

25. Operating device according to one of the preceding claims, characterised in that the drive unit is an electric

motor, an electromagnetic or electromechanical unit.

26. Operating device according to one of the preceding claims, characterised in that the drive unit is a pressurised medium operated drive unit such as a hydraulic, hydropneumatic or pneumatic drive unit.

27. Operating device more particularly according to one of the preceding claims, characterised in that a force action of the output element modulated through the operating path of the output element takes place on the output element of the operating device as a result of movement of the three-dimensionally geometric contour and the force-biasing of this contour.

28. Operating device according to one of the preceding claims, characterised in that the force support is provided at least over a partial area of the operating path of the output element.

29. Operating device according to one of the preceding claims, characterised in that the force support undergoes where applicable a change of sign during the course of the operating path.

30. Operating device for controlling an operable control element, more particularly for shifting and/or selecting the transmission ratio of a gearbox and/or for operating a torque transfer system in the drive train of a motor vehicle, the operating device has a drive unit and where applicable a gearbox as well as an output element in active connection therewith through a drive connection for operation, with at least one energy accumulator which can bias the output element, characterised in that the force action of the at least one energy accumulator acts on the output element wherein the at least one energy accumulator

is mounted to act as a from-dead-point spring.

31. Operating device according to claim 30 characterised in that two energy accumulators are arranged opposite one another and each bias the output element as from-dead- point spring.

32. Operating device according to claim 30 characterised in that the at least one energy accumulator is arranged as a from-dead-point spring so that a first end area is swivel mounted on the output element and the second end area is swivel mounted for example on the housing.

33. Operating device, more particularly according to one of the preceding claims for controlling an operable control element, for example for shifting and/or selecting the transmission ratio of a gearbox and/or for operating a torque transfer system, in the drive train of a motor vehicle, the operating device has a drive unit and where applicable a gearbox as well as an output element in active connection therewith through a drive connection for operation, with at least two energy accumulators biasing the output element characterised in that the force action of the at least two energy accumulators acts on the output element wherein the two energy accumulators are arranged as energy accumulators connected in series.

34. Operating device according to one of the preceding claims, characterised in that at least one energy accumulator is a pretensioned energy accumulator.

35. Operating device according to one of the preceding claims, characterised in that the at least one energy accumulator is a spring, such as compression spring, leaf spring, loop spring or an elastic element of metal, rubber-like material or of plastics.

36. Operating device according to one of the preceding claims, characterised in that the element with the three dimensionally geometric contour is of metal or plastics.

37. Operating device according to one of the preceding claims, characterised in that the element with the three dimensionally geometric contour is formed integral with a gear component.

38. Operating device according to one of the preceding claims, characterised in that the element with the three dimensionally geometric contour is formed integral with the output element.

39. Operating device according to one of the preceding claims, characterised in that the element with the three dimensionally geometric contour is formed integral with an element in the active connection between the drive unit and the output element.

40. Operating device according to one of the preceding claims, characterised in that the element with the three dimensionally geometric contour is connected to an element in the active connection between the drive unit and the output element.

41. Operating device for controlling an operable control element substantially as herein described with reference to the accompanying drawings.

The Patent Office

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Application No:	GB 9711400.3	**Examiner:**	Tom Sutherland
Claims searched:	1 - 29	**Date of search:**	2 September 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F2D (DDA, DBB, DDF); F2L (LAX, LK, LT, LR)

Int Cl (Ed.6): F16D 27/00, 29/00; F16H 63/30

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2207969 A	(SACHS) Fig. 1.	1, 2
Y	GB 2161237 A	(VALEO) Fig. 2, spring 33.	1, 2
Y	GB 1185396	(HONDA) Fig. 1, page 2 lines 33 to 40.	1, 2
Y	WO 95/35452 A	(VALEO) Fig. 1, spring 15, compensation means 17.	1, 2

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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